Massachusetts Military Reservation

Final
3rd Five-Year Review, 2002-2007
Massachusetts Military Reservation (MMR)
Superfund Site
Otis Air National Guard Base, MA
September 2008

Prepared for:
AFCEE/MMR
Installation Restoration Program
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13. ABSTRACT (*Maximum 200 words*) This document has been prepared to evaluate the implementation and performance of cleanup remedies at the MMR Superfund Site, in order to determine if these remedies are or will be protective of human health and the environment. All 80 source areas and 16 groundwater plumes designated in the Federal Facilities Agreement were evaluated according to the EPA guidance for five-year reviews. The primary focus of this document is the technical assessments and any subsequent issues and required follow-up actions that relate to the continued protectiveness of the cleanup actions associated with each site.			
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ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services, Inc.
AFCEE	Air Force Center for Engineering and the Environment
AM	Action Memorandum
ANG	Air National Guard
AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
ARNG	Army National Guard
AS	air sparging
ASI	Advanced Sciences Incorporated
AST	aboveground storage tank
AV	Ashumet Valley
AVGAS	aviation gasoline
BEHP	bis(2-ethylhexyl) phthalate
BIP	blown in place
BOH	Board of Health
BOMARC	Boeing Michigan Aerospace Research Center
BTEX	benzene, toluene, ethylbenzene, xylene
CCl_4	carbon tetrachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)
CDC	Confined Detonation Chamber
cfm	cubic feet per minute

ACRONYMS AND ABBREVIATIONS

CIA	Central Impact Area
cis-1,2-DCE	cis-1,2-dichloroethene
CLP	Contract Laboratory Program
COC	contaminant of concern
COPC	contaminant of potential concern
cPAH	polycyclic aromatic hydrocarbon
CPT	current product tank
CRQL	Contract Required Quantitation Limits
CS	Chemical Spill
CSA	Central Staging Area
CWMA	Crane Wildlife Management Area
CWSW	Coonamessett Water Supply Well
CY	Coal Yard
DCM	Decision Criteria Matrix
DDD	1,1-dichloro-2,2-bis(p-chlorophenyl(ethane)
DDE	dichlorodiphenyldichloroethene
DDOU	Drum Disposal Operable Unit
DDT	dichlorodiphenyltrichloroethane
DEQE	Department of Environmental Quality Engineering
DMM	Discarded Military Munitions
DoD	Department of Defense
DPDO	Defense Property Disposal Office

ACRONYMS AND ABBREVIATIONS

DSRP	Drainage Structure Removal Program
EAT	Eastern Aircraft Turnaround
EDB	ethylene dibromide
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbon
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Difference
ETD	extraction, treatment, and discharge
ETI	extraction, treatment, and infiltration
ETR	extraction, treatment, and reinjection
FIW	Fighter-Interceptor Wing
FS	Fuel Spill
FSUP	Fuel Systems Upgrade Program
FTA	Fire Training Area
ft bgs	feet below ground surface
GAC	granular activated carbon
gpm	gallons per minute
GP	Gun Position
GPR	ground-penetrating radar
HA	health advisory
HATF	Hunter Avenue Treatment Facility

ACRONYMS AND ABBREVIATIONS

HEC	hazard equivalent concentration
HI	hazard index
HHRA	human health risk assessment
IROD	Interim Record of Decision
IRP	Installation Restoration Program
J	estimated value
JP-4	Jet Fuel-4
lbs	pounds
LF	Landfill
LTM	long term monitoring
LUC	Land Use Control
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
MD	munitions debris
MEC	Munitions of Explosive Concern
mg/kg	milligrams per kilogram
MMCL	Massachusetts Maximum Contaminant Level
MMR	Massachusetts Military Reservation
MW	monitoring well
NCP	National Contingency Plan
NDIL	Non-Destructive Inspection Laboratory

ACRONYMS AND ABBREVIATIONS

NGB	National Guard Bureau
NOR	Notice of Responsibility
NWOU	Northwest Operable Unit
ORNL	Oak Ridge National Laboratory
OWS	oil/water separator
PA	Preliminary Assessment
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
pCi	picoCuries
PFSA	Petroleum Fuels Storage Area
PID	photoionization detector
POL	petroleum-based oils and lubricants
ppm	parts per million
PRA	preliminary risk assessment
PRE	preliminary risk evaluation
PRG	Preliminary Remediation Goals
RAH	Risk Assessment Handbook
RAIS	Risk Assessment Information System
RAL	removal action level
RAO	Remedial/Removal Action Objective
RAR	Remedial/Removal Action Report

ACRONYMS AND ABBREVIATIONS

RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosive
RI	Remedial Investigation
ROD	Record of Decision
RRD	range related debris
SARAP	Source Area Remedial Action Program
SD	Storm Drain
SERGOU	Southeastern Regional Groundwater Operable Unit
SI	Site Investigation/Inspection
SITM	Site Inspection Technical Memorandum
SOU	Soil Operable Unit
SPEIM	System Performance and Ecological Impact Monitoring
SRTF	Sandwich Road Treatment Facility
SSI	Supplemental Site Investigation/Inspection
STCL	soil target cleanup level
STP	sewage treatment plant
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWOU	Southwest Operable Unit
SWP	shallow wellpoint
TAL	target analyte list
TBC	To Be Considered

ACRONYMS AND ABBREVIATIONS

TCE	trichloroethene
TCL	Target Compound List
TCLP	toxicity characteristic leaching procedure
TMB	trimethylbenzene
TPH	total petroleum hydrocarbon
TSDF	Treatment Storage and/or Disposal Facility
TRET	Technical Review and Evaluation Team
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAEHA	U.S. Army Environmental Hygiene Agency
USAF	U.S. Air Force
UCRTS	Upper Cape Regional Transfer Station
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
UST	underground storage tank
UTES	Unit Training Equipment Site
UV/OX	ultraviolet light/oxidation
UXO	unexploded ordnance
VC	vinyl chloride
VI	vapor intrusion
VMB	vehicle maintenance building
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon

ACRONYMS AND ABBREVIATIONS

WAT	Western Aircraft Turnaround
WWII	World War II
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
1,1,1-TCA	1,1,1-trichloroethane
1,1,2,2-TeCA	1,1,2,2-tetrachloroethane

1.0 INTRODUCTION

1.1 SITE LOCATION AND DESCRIPTION

The Massachusetts Military Reservation (MMR) Superfund Site is located on western Cape Cod in Barnstable County, Massachusetts, approximately 60 miles south of Boston and immediately southeast of the Cape Cod Canal. It occupies approximately 22,000 acres within the towns of Bourne, Falmouth, Mashpee and Sandwich. The MMR is organized into four principal functional areas:

Range Maneuver and Impact Area. This area consists of approximately 16,000 acres occupying the northern 70% of MMR and is used for training and maneuvers.

Cantonment Area. This area consists of approximately 5,000 acres in the southern portion of MMR and is the location of the administrative, operational, maintenance, housing, and support facilities and the flightline for Otis Air National Guard (ANG) Base, U.S. Coast Guard (USCG) Air Station Cape Cod, and the Army National Guard's (ARNG) Camp Edwards.

Massachusetts National Cemetery. This area consists of approximately 750 acres along the western edge of MMR and contains the Veterans Administration cemetery and support facilities.

Cape Cod Air Station. This area occupies 100 acres of the northern portion of the Range Maneuver and Impact Area and consists of the U.S. Air Force (USAF) fixed base phased array warning system known as PAVE PAWS.

1.2 LAND USE AND SITE HISTORY

Military use of portions of MMR began as early as 1911. From 1911 to 1935, the Massachusetts National Guard periodically camped to conduct maneuvers and weapons training in portions of the Shawme Crowell State Forest. In 1935, the Commonwealth of Massachusetts purchased the area now occupied by MMR for permanent training facilities. Most of the activity at MMR has occurred since 1935, including operations by the U.S. Army, the U.S. Navy, USCG, USAF, Massachusetts ARNG, Massachusetts ANG, and the Veterans Administration.

In general, two different types of operations have dominated military activity at MMR: (1) mechanized army training, maneuvers, and maintenance support (Camp Edwards) and (2) military aircraft operations, maintenance, and support [Otis Army Air Field/Air Force Base/Coast Guard Air Station]. The level of activity has varied over the MMR operational history. The most intensive U.S. Army activity occurred during World War II (WWII) (1940-1944) and during demobilization following the war. During the last two years of WWII, the U.S. Navy used the MMR runways, flightline, and housing areas for advanced naval aviation carrier-based flight training.

The most intensive air craft operations occurred from 1955 to 1970, when large numbers of surveillance and air defense aircraft operated from MMR. Then, the USAF operated 45 EC-121 (Super Constellation) Airborne Early Warning and Control aircraft and a Fighter-Interceptor Wing (FIW) from MMR.

A major military hospital was in operation at MMR from WWII to 1970. Immediately following WWII, the hospital was a major orthopedic rehabilitation center. In the early 1970s, the hospital was decommissioned and demolished.

The intensive periods of activity occurred under separate organizational control and were staged in two separate portions of the Cantonment Area. The WWII period of activity occurred under U.S. Army control when MMR had been federalized and was known as Camp Edwards. Large-scale motor pool activities and troop billeting occurred in the center of the Cantonment Area. These operations were carried out in units surrounding a central parade ground, as bounded on four sides by West, South, East, and North inner Roads. During WWII, air operations at Otis Army Airfield were reportedly of a relatively low level of intensity. The most intensive aircraft operations occurred along the expanded flightline areas located in the southeastern portion of the Cantonment Area, under USAF control. From 1962 to 1972, a Boeing Michigan Aeronautical Research Center (BOMARC) air defense missile installation was located at MMR. During the 1970s, the Strategic Air Command also used the runways at MMR to park refueling aircraft.

In 1970, the airborne surveillance activity was phased out. The air defense mission was carried on by the USAF until 1973, when this mission, as well as management of the base (now known as the MMR), was transferred to the 102nd FIW of the Massachusetts ANG. In March 1992, the 102nd was redesignated the 102nd Fighter Wing. The mission of the 102nd was also revised to include such functions as drug interdiction and aiding aircraft in distress.

Other major operations have been ongoing at MMR. The ARNG and U.S. Army Reserve training has been carried out at variable levels since the early 1950s. The USCG began operations at Air Station Cape Cod at MMR in 1970. Since 1978, the USAF has operated the PAVE PAWS missile and space vehicle tracking system from Cape Cod Air Force Station, located at the northern end of MMR, and in 1978, the Veterans Administration acquired 750 acres in the western portion of MMR to develop the Massachusetts National Cemetery, which began operations in 1980. There are five major organizations now using MMR. They are the Massachusetts ARNG, operating Camp Edwards; the ANG/Massachusetts ANG, operating Otis ANGB; the USAF, operating Cape Cod Air Force Station; the USCG, operating Air Station Cape Cod; and the Veterans Administration, operating the Massachusetts National Cemetery.

Activities at MMR that have the potential for contaminating the environment have included the storage, handling, and disposal of solvents and petroleum fuels as well as the leakage of these materials into storm water drainage systems and the sanitary sewer system. Landfill operations, firefighter training, coal and ash storage, sewage treatment, and numerous chemical and fuel spills have also resulted in environmental contamination.

1.3 PURPOSE OF THE FIVE-YEAR REVIEW

The purpose of the five-year review is to evaluate the implementation and performance of a site cleanup remedy in order to determine if the remedy is or will be protective of human health and the environment. The U.S. Environmental Protection Agency (EPA) guidance for five-year reviews (OSWER 540-R-01-007, dated June 2001) requires each

Site be evaluated and three questions answered regarding the protectiveness of the cleanup actions that have occurred or are occurring at the Site. These three questions are:

A. ***Is the remedy functioning as intended by the decision documents?***
B. ***Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?***
C. ***Has any other information come to light that could call in to question the protectiveness of the remedy****?*

For the purposes of this five-year review, the word “Site” (capital “S”) refers to the collection of all the individual source areas and ground water sites at the MMR that are being cleaned up pursuant to the Federal Facility Agreement for the MMR Superfund Site, signed July 17, 1991 and its amendments. Each of the individual sites was evaluated pursuant to the five-year review guidance. The methods, findings, and conclusions of the reviews are documented within this five-year review report. In addition, this five-year review report identified certain issues found during the review and identified specific recommendations to address them.

The Air Force Center for Engineering and the Environment (AFCEE) prepared this five-year review report pursuant to Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund) (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the Site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such Site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

EPA interpreted this requirement further. In the NCP, 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the Site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

In addition to these statutory categories of five-year review, section 1.2.1 of EPA's guidance also provides for policy-based five-year reviews:

> *Five-year reviews generally should be conducted as a matter of policy for following types of actions:*
>
> *• A . . . remedial action that, upon completion, will not leave hazardous substances, pollutants, or contaminants on site above levels that allow for unlimited use and unrestricted exposure, but requires five years or more to complete . . . ;*
>
> *• A removal-only site on the NPL where a removal action leaves hazardous substances, pollutants, or contaminants on site above levels that allow for unlimited use and unrestricted exposure and where no remedial action has or will take place.*

This is the third five-year review for the MMR Superfund Site, covering the period 2002-2007. The triggering action for the statutory review process for MMR began with the initiation of the remedial action on-site construction date of the Chemical Spill No.4 (CS-4) treatment system on October 15, 1992. As a result of this triggering action, the first five-year review, covering the period 1992-1997, was published in March 1999. Subsequently, the second five-year review, covering the period 1998-2002 was published in May 2003.

This five-year review is required at the MMR Superfund Site because hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

1.4 REQUIREMENTS OF THE FIVE-YEAR REVIEW

According to the EPA guidance, the five-year review must, for each Site:

- *describe the Site's* ***chronology*** *and* ***background****,*
- *summarize the* ***remedial actions*** *that have taken place at the Site,*
- *describe the* ***progress*** *in the CERCLA cleanup process that has taken place at the Site* ***since the last review*** *(if applicable),*
- *outline the actual five-year review* ***process*** *conducted on the Site,*
- *do a* ***technical assessment*** *of the Site,*
- *describe any* ***issues*** *arising from the review process,*
- *make* ***recommendations*** *and* ***follow-up actions*** *needed at the Site, and*
- *provide a* ***statement of protectiveness*** *for the Site.*

1.4.1 Exception

Under EPA policy, if cleanup at a site is deferred to a corrective action order under another statute (such as the Resource Conservation and Recovery Act or the Safe Drinking Water Act), it is not necessary to conduct a conduct a five-year review. Therefore, the contaminated sites at MMR that are being cleaned up by the MMR Impact Area Ground Water Study Program, pursuant to the U.S. EPA Region 1 Administrative Order, under the authority of the Safe Drinking Water Act, are **not** included in this report.

1.5 METHODOLOGY

This five-year review report covers multiple remedies and operable units in the MMR cleanup program. Regardless of whether operable units or areas of concern are active or inactive, each MMR Installation Restoration Program (IRP) site was evaluated according to the EPA guidance for five-year reviews. Table 1-1 provides a list of all MMR source area and groundwater sites and Figure 1-1 illustrates their locations. The status and progress of each site in the CERCLA cleanup process was considered in each evaluation. Figure 1-2 is a flow diagram that shows how this process works. The primary focus of this document is the technical assessment and any subsequent issues and required follow-

up actions that relate to the continued protectiveness of the cleanup actions associated with each site. The following subsections are major components of the five year review.

1.5.1 Site Data

A summary of information about each site has been provided, for background purposes. Each site's history is outlined, explaining what occurred at the site and how it became contaminated, if this information is known. In addition, the specific actions that were taken at each site, from investigation through clean up, are also summarized.

References are provided to all documents supporting the history, investigations, and cleanup decisions for each site. The reader may find the individual reports in the official Administrative Record of the MMR Superfund Site. This record is physically maintained at the MMR IRP Offices, located in Building 322 on Otis ANGB, MA. Electronic copies of documents may be found on-line at **http://www.mmr.org**, by clicking on **"Administrative Record"** under the main title block. In addition, the public libraries in the four towns surrounding MMR can help locate and obtain copies of specific documents using their on-line reference systems. Finally, a hard copy of the index of the MMR IRP Administrative record documents is maintained at the Falmouth Public Library.

1.5.2 Interviews and Site Inspections

Five-year review specific interviews were not conducted in preparation for this document because interviews were already conducted at MMR during the "Records Search" phase (late 1980s) of base-wide investigations to determine which areas to focus the cleanup program. As for any new potential sites, interviews, which are being conducted as part of the Impact Area cleanup project, are evaluated as they pertain to the IRP. During this review period, no new sites were identified as a result of those interviews.

Additionally, no five-year review specific site inspections were conducted because sites are routinely inspected as part of end-of-construction activities and ongoing operation and maintenance at ground water treatment plants.

1.5.3 Technical Assessments

Technical assessments were made of every site requiring a five-year review to determine the current level of protectiveness of the cleanup actions that have occurred or are occurring at each site. The three questions listed in Section 1.0 guided these technical reviews.

For sites where a remedy is still functioning, Question A requires an assessment of whether the remedy is still functioning as intended by the decision documents. This assessment was done by examining the histories of the groundwater treatment system annual reports, the source area treatment system operating reports, and the status of any institutional control procedures required by the decision documents.

Question B requires that the assumptions and criteria used when the decisions were made to do the remedial actions and to eventually close the sites be reexamined using today's standards. Question C requires the Remedial Program Manager to examine any other information that may have come to light regarding the protectiveness of the selected remedy and the decision to close the site. These two questions apply to all sites, even those that were closed without performing a remedial action.

In doing these technical assessments, all the cleanup levels that were factored in the decisions for these sites were checked against current cleanup levels to make sure that a more conservative remedial action objective cleanup standard would not now be required. If a Maximum Contaminant Level (MCL) that was used in an on-going or completed cleanup action has now become more restrictive, then the affected decision would have to be reevaluated using today's standards and adjustments to the cleanup process for that site would have to be made.

The technical assessments used information gathered during the routine surveillance of MMR soils and groundwater over the reporting period, as well as inputs from the community, to determine if conditions along the exposure pathways and at the receptors, for example, had changed at any of the sites. Typical situations that would drive a

reassessment of the remedy's effectiveness and protectiveness would be a shift in a groundwater plume's direction of migration or new homes having been built in the vicinity of a plume. Again, the visibility of the MMR IRP activities assures these kinds of changes are routinely picked up and their consequences considered.

The public plays a vital role in the oversight of the MMR IRP cleanup program. Information from the community regarding these sites, or potential new sites, was evaluated and considered in the technical assessments.

1.5.4 Summary of Issues and Follow-up Actions

During the process of the five-year review, some specific issues were identified at certain sites. Although none of these put the overall protectiveness of any of the remedies in jeopardy, these issues are important to the overall IRP program. As a result, recommendations were made as part of this report and the means for following up these recommendations were identified and summarized in Table 1-2. Although none of these issues adversely affects the status of any of the site's protectiveness, the resulting recommendations will be tracked through the regular activities of the MMR IRP stakeholder groups, which include community advisors and the regulators.

1.5.5 Protectiveness Statement

All existing cleanup remedies were found to be either currently protective of human health and the environment, protective in the short term, or are expected to be protective of human health and the environment upon attainment of groundwater cleanup goals.

Long-term protectiveness of the on-going and future remedial actions will be verified by obtaining ground water samples to fully evaluate the potential migration of the ground water plumes. Appropriate actions will be taken to assure continued protectiveness or progress towards ultimate protectiveness should this monitoring suggest risks may or have become unacceptable.

Protectiveness assessments for sites currently under investigation were deferred, as allowed by the guidance. All these sites were evaluated; however, and found to pose no imminent or substantial endangerment to human health or the environment.

1.6 SITE CATEGORIZATION

MMR IRP sites have been divided into three general categories. The three categories of sites are as follows:

- **IRP Sites Not Requiring a Five-Year Review:** These sites have progressed through one or more CERCLA investigation or remedial action phases which have resulted in no further action required for unrestricted use. Section 2.0 presents MMR IRP sites that do not require a five-year review.
- **IRP Source Area Sites Requiring a Five-Year Review:** These sites require a five-year review because they are under investigation, remedial action has not been completed; or the site has restricted use. Section 3.0 presents MMR IRP source area sites that require a five-year review.
- **IRP Groundwater Sites Requiring a Five-Year Review:** These sites require a five-year review because they are under investigation, remedial action has not been completed; or the site has restricted use. Section 4.0 presents MMR IRP groundwater sites that require a five-year review.

1.7 NEXT REVIEW

The next five-year review for the MMR Superfund Site is required by December 2012, five years from the date of the start of this review.

2.0 INSTALLATION RESTORATION PROGRAM SITES NOT REQUIRING FIVE-YEAR REVIEW

This section presents IRP sites, which are categorized as Areas of Contamination (AOCs) or Study Areas that do not require a five-year review. There are no land-use restrictions for these AOCs and Study Areas. Study Areas or AOCs that are not subject to a five-year review must meet one of the following conditions:

(1) Preliminary Assessment (PA): The Study Area received a no further action determination based on records search, visual inspection, and/or results of limited sampling.

(2) Site Inspection (SI): The Study Area received a no further action determination based on sampling results and/or a preliminary risk assessment (PRA) using a residential exposure scenario.

(3) Remedial Investigation (RI): The SI recommended a RI for an AOC; however, results of the RI sampling program and human health risk assessment (HHRA) (based on residential exposure scenario) indicated that no further action was required for unrestricted use.

(4) Remedial Action/Removal Action was performed at the AOC which allowed unrestricted use. Confirmation samples were based on MMR-specific cleanup levels based on residential exposure and/or Massachusetts Department of Environmental Protection (MassDEP) S-1/GW-1 standards.

Table 2-1 presents twenty seven IRP sites that do not require a five-year review.

3.0 SOURCE AREA SITES REQUIRING FIVE-YEAR REVIEW

This section presents Source Area sites for which a five-year review is required. Thirty-nine sites require a five-year review because of one of the following conditions:

- remedy/removal action or no further action decision was completed within the five-year timeframe (i.e., 2002-2007);
- remedy has not been completed;
- the site is under investigation; or
- the site has restricted use based on residual contamination or exposure scenarios used in risk assessments.

Table 3-1 presents source area sites that are part of this five-year review. A component of the five-year review is to assess the protectiveness of implemented actions or no further action decisions based on current and/or anticipated land-use. In order to assess protectiveness, risk analyses and implemented actions conducted for the IRP need to be evaluated. The following subsections describe the risk assessment process used for the IRP as well as the remedial action/removal actions. Furthermore, land-use control status is discussed.

3.1 HUMAN HEALTH RISK ANALYSIS

For many sites, the human health risk assessment process followed the procedures described in the MMR IRP Risk Assessment Handbook (RAH) (ASG 1993). A tiered approach was used to determine the following decision/actions: no further action, RI, or removal action. In order to determine if past no further actions and implemented actions remain protective, the risk analyses used must be evaluated to determine if those analyses would be valid if compared to current risk methodologies. Furthermore, toxicological data may have been updated and could have an impact on risk determination. Two primary exposure scenarios are likely for the MMR: residential and worker/industrial. Exposure scenarios were generally based on whether the site was located inside or outside the flightline.

Two levels of human health risk analyses were performed to support the no action/action decision making process for the IRP cleanup program. They included a screening level assessment which was called a "Preliminary Risk Evaluation (PRE)" and human health risk assessment called a "Preliminary Risk Assessment (PRA)" which was typically performed in the RI phase. It should be noted that IRP sites may have several types of analysis (e.g., Residential PRE for surface soil and groundwater and a worker PRE for subsurface soil). The risk analyses are summarized below:

PRE: Screening analysis using tiered (Tier I and Tier II) approach performed in the SI phase. The Residential PRE was used primarily for surface soil (0-2 feet below ground surface [ft bgs]), sediment, and all groundwater. The Worker PRE was used primarily for subsurface soil (>2 ft bgs) and "inside the flightline" sites.

PRA: If Tier I risk/Hazard Equivalent Concentrations (HECs) were exceeded, a PRA was performed (called Tier III for human health). All relevant pathways were quantified using maximum and mean concentrations.

3.1.1 Preliminary Risk Evaluation

The Tier I evaluation consisted of comparing maximum contaminant concentrations to risk/hazard-equivalent concentrations (HECs) for the media that represent the most significant pathways. Risk parameters for HECs were developed based on EPA Guidance. The Tier I HEC values were based on a risk of $1x10^{-6}$ and an HI of 0.2 which are highly conservative. Pathways considered included inhalation, dermal, and ingestion. Tier II risk/HECs were not used to determine validity of a PRE because these values were back-calculated using values outside of EPA' s acceptable risk range. Evaluation of Tier II risk/HECs were used primarily for determining the need for an immediate response action. Several sites used USEPA Region IX Preliminary Remediation Goals (PRGs) as screening levels. These values were back-calculated with a risk of $1x10^{-6}$ and an HI of 1.0.

Provided below is a summary of screening risk analyses used for MMR IRP sites. In general, screening level values are protective when compared to current standards. It should be noted that actual risk is reduced by implemented removal/remedial actions and exposure is largely mitigated by controlled access and land management practices associated with military installation operations. Furthermore calculated risk should be considered conservative because maximum concentrations were used for comparison to screening levels and for carcinogens, the screening levels were back-calculated based on risk of $1x10^{-6}$.

Priority Two and Priority Three Site Inspection (SI) Screening Levels

Risk/HECs were first developed for the Priority Two and Priority Three Site Inspection (SI) (ANG 1993). The Priority Two and Priority Three sites for which a PRE was performed are: CS-2 (USCG), CS-4 (USCG)/Fuel Spill-1 [FS-1] (USCG), CS-5, CS-6 (USCG), CS-9, CS-11, CS-14, CS-15, FS-2 (USCG), FS-4, FS-7, FS-14, FS-18, FS-19, and Landfill-1 [LF-1] (USCG).

The Priority Two and Priority Three SI residential risk/HEC values in most cases are more stringent than the current Oak Ridge National Laboratory (ORNL) Risk Assessment Information System (RAIS) PRGs (Table 3-2). Tier I residential risk/HECs only exceeded respective ORNL RAIS PRGs by a magnitude of two (100 times) for the following chemicals: tetrachloroethene (PCE), trichloroethene (TCE), and 1,2,3-trichloropropane. Risk/HECs for these chemicals exceed the upper limit of EPA's acceptable risk range if the ORNL RAIS PRG if back-calculated based on a risk of $1x10^{-4}$. These chemicals however were not expected to be detected in soils at concentrations exceeding current ORNL RAIS PRGs where the decision was no further action based on a residential PRE evaluation.

The Priority Two and Priority Three SI worker risk/HEC values in most cases were within one order of magnitude (10 times) than the current ORNL RAIS PRGs which would be equivalent to a back-calculation of $1x10^{-5}$ assuming the most stringent ORNL RAIS PRG was a carcinogenic value (Table 3-3). Tier I residential risk/HECs exceeded

respective ORNL RAIS PRGs by a magnitude of two (100 times) for the following chemicals: PCE, TCE, and 1,2,3-trichloropropane. Risk/HECs for these chemicals exceed the upper limit of EPA's acceptable risk range if the ORNL RAIS PRG if back-calculated based on a risk of $1x10^{-4}$. Sites for which Priority Two and Priority Three SI worker risk/HEC values were used for decision-making purposes included CS-2 (USCG), CS-4 (USCG)/FS-1 (USCG), CS-6 (USCG), CS-14, and FS-2 (USCG), and FS-18. Additional action or sampling was performed at all sites with the exception of CS-6 (USCG) and FS-2 (USCG). These chemicals (i.e., PCE, TCE, and 1,2,3-trichloropropane) were not expected to be detected in soils at concentrations exceeding current ORNL PRGs . Based on review of existing analytical data and to determine if Land Use Controls (LUCs) are required, AFCEE is planning on evaluating all of these sites for unrestricted use.

Post CY1993 Risk/HEC Screening Levels

Risk/HEC values were revised after CY1993. Sites that had PREs completed after CY1993 included CS-1, CS-4 (soil), CS-6/FS-22, FS-1, and FS-12. PREs for these sites were based on worker exposure scenarios with the exception of CS-4 soil. The PRE for CS-4 soil was based on residential exposure. The data used in the PRE is no longer representative of CS-4 soil because a soil removal action using primarily ecological-risk based removal action levels (RALs) was implemented (see Section 3.3.2). These RALs are more stringent than ORNL RAIS PRGs with the exception of polychlorinated biphenyls (PCBs) (Table 3-4). The cleanup of 1.0 milligram per kilogram (mg/kg) for PCBs was based on a cleanup level agreed to by stakeholders during the development of RALs for the Source Area Remedial Action Program (SARAP). A comparison of post-CY1993 worker-based PRE risk/HECs with current screening values is not provided because these sites with post-CY1993 PRE risk/HECs have issues that may not provide an accurate representation of risk at the site (e.g., use of surface soil data in a subsurface soil PRE). AFCEE is planning on reevaluating these sites with current residential screening levels to determine if LUCs are required.

<u>EPA Region IX PRG Screening Levels</u>

EPA residential risk-based PRGs were used as screening levels for several sites. CY2001 EPA residential risk-based PRGs were used for CS-8 (USCG) and CS-22. Removal actions were performed at these sites using cleanup levels that are more stringent the current ORNL RAIS PRGs with the exception of arsenic, PCBs, benzo(a)pyrene, and dibenz(a,h)anthracene (Table 3-4). The RAL for arsenic is based on background. The difference in PAH values is less than two orders of magnitude, which would be within EPA's acceptable risk range. These sites are expected to be allowable for unrestricted use because of the use of CY2001 EPA Region IX residential PRGs and removal action using SARAP RALs. The human health screening analysis for FS-13 soil used the more stringent of CY2004 EPA Region IX PRGs and MassDEP S-1/GW-1 standards. Several screening values were exceeded, however a no further action decision was made based on level of contamination, detection frequency and other factors.

3.1.2 Preliminary Risk Assessment

PRAs were completed for sites for which Tier I PREs were exceeded and/or a RI was performed. The PRA consisted of five major components: (1) data evaluation and the identification of COCs; (2) exposure assessment; (3) toxicity assessment; (4) risk characterization; and (5) uncertainty analysis. Preparation of a PRA followed a phased approach described in the RAH as well as EPA and MassDEP risk guidance. Because risk assessment parameters such as toxicity values, exposure parameters, etc., may have changed over time, it was agreed upon by stakeholders that an existing PRA would remain valid in terms of a decision-making process/protectiveness if the calculated risk was equivalent or less than 1x 10^{-5} and a HI of 1.0. There are instances where the calculated risk/HEC slightly exceeded the threshold. These exceedances are explained in the individual site assessments and in Table 3-1. PRAs were performed for both worker and residential exposure scenarios.

3.2 ECOLOGICAL RISK ANALYSES

Nearly all IRP sites were evaluated for ecological risk. Results of many ecological risk analyses indicated that there were potential adverse effects from exposure to contaminants; however, site characteristics, (e.g., physical size of site, land use, etc.) was used in the decision-making process for whether or not to take action. Ecological risk triggered the need to action for several sites. Removal and remedial actions conducted as part of the SARAP (described in Section 3.3) was primarily based on ecological-risk. Ecological-risk cleanup focused on surface soil. Ecological risk -based cleanup levels were typically much more stringent than human health residential screening levels. If an ecological-risk remedial/removal action was conducted at a site, surface soil at the site should be available for unrestricted use regardless what type of human health risk analysis was performed.

3.3 REMEDIAL AND REMOVAL ACTIONS

Two major multi-site remedial action programs addressing soil contamination were implemented at the MMR IRP. They are the Drainage Structure Removal Program (DSRP) and the SARAP. Other removal activities (i.e., underground storage tanks) were conducted and are discussed in site-specific Technical Assessments. Remediation conducted under the DSRP and SARAP should be considered protective based on a comparison of cleanup levels used for those remedial/removal actions with current ORNL RAIS PRGs. The DSRP and SARAP are discussed below.

3.3.1 Drainage Structure Removal Program

The DSRP was a CERCLA removal action program for which drainage structures and associated contaminated soils were removed throughout the installation. Table 3-1 indicates sites where a DSRP removal action was implemented. The DSRP cleanup levels, called Soil Target Cleanup Levels (STCLs), were developed using the MMR RAH (ANG 1993). The cleanup levels were based on if the removal action was located outside or inside the flightline. "Outside the flightline" STCLs were based on a residential exposure scenario. "Inside the flightline" STCLs were based on a worker exposure scenario. STCLs also took into consideration ecological risk and leaching potential (based on K_{oc} value of the chemical). The STCLs are protective based on comparison with current ORNL RAIS PRGs.

Table 3-5 provides a comparison DSRP residential-based STCLs with the most stringent of the ORNL RAIS residential PRGs. Most of the DSRP residential-based STCLs are within one order of magnitude (10 times) of the most stringent ORNL RAIS worker PRG. No DSRP residential-based STCL would have exceeded an ORNL RAIS PRG that would have been back-calculated with a risk of $1x10^{-4}$ which is the limit of what EPA considers an acceptable risk. Because no DSRP residential-based STCL would have been less stringent than the respective ORNL RAIS PRG if back-calculated with a risk of

1×10^{-4}, all "outside the flightline" DSRP removal actions should still be considered protective and valid based on residential exposure scenarios.

Table 3-6 provides a comparison DSRP worker-based STCLs with the most stringent of the ORNL RAIS outdoor worker/excavation work exposure scenario PRGs. Most of the MMR RAH Tier I worker-based STCLs are within one order of magnitude of the most stringent ORNL RAIS worker PRG. No DSRP worker-based STCL would have exceeded an ORNL RAIS PRG that would have been back-calculated with a risk of 1×10^{-4} which is the limit of what EPA considers an acceptable risk. Because no DSRP worker-based STCL would have been less stringent than the respective ORNL RAIS PRG if back-calculated with a risk of 1×10^{-4}, all "inside the flightline" DSRP removal actions should still be considered protective and valid based on worker exposure scenarios.

3.3.2 Source Area Remedial Action Program (Excavation Sites)

The SARAP included remedial actions, removal actions, and remedial delineation sampling for the following sites: CS-4, CS-4 (USCG)/FS-1 (USCG), CS-5, CS-8 (USCG), C-10/CS-24, CS-11, CS-16/CS-17, CS-22, DDOU, FS-9, FS-13 (soil), FS-18, Storm Drain-2 [SD-2]/FS-6/FS-8, SD-3/Fire Training Area-3 (FTA-3)/CY-4, and SD-5/CY-5. The SARAP program consisted primarily of ecological-risk based driven remedial and removal actions. Delineation and confirmation sampling used DSRP STCLs for organic COCs and CY 2001 RALs for inorganic COCs. The cleanup levels for the SARAP sites are documented in the SARAP Explanation of Significant Difference (ESD) (AFCEE 2003). All of the CY2001 ecological-risk based inorganic RALs are more stringent than the current residential ORNL RAIS PRGs (Table 3-7). Therefore, surface soil at sites should be considered allowable for unrestricted use for which SARAP remedial/removal actions have been completed.

3.3.3 Sites with Leaching-Based Contaminants of Concern

IRP sites were also evaluated for impact to groundwater. PFSA/FS-10/FS-11, FS-12, FTA-2/LF-2, SD-5/FS-5, and CS-10 Detail C are sites where various forms of air sparging/soil vapor extraction systems were used/or currently treating volatile organic compounds in subsurface soil that potentially could impact groundwater. Highly conservative leaching-based STCLs from the DSRP were used for cleanup levels. However for several sites (e.g., SD-5/FS-5, CS-10 Detail C), AFCEE, with regulatory agency approval, performed impact-to-groundwater analysis which included evaluating groundwater data and vadose zone modeling to shut down treatment systems. Because Record of Decision (ROD) cleanup levels were not the basis for system shutdown, a comparison of impact-to-groundwater screening levels/cleanup levels with current screening levels was not performed.

3.4 LAND USE CONTROLS FOR SOURCE AREA SITES

3.4.1 Land Use Control Requirement for IRP Source Area Sites Located Within Installation Fence Line

The majority of IRP sites are located within the installation fence line. Within the installation fence line, sites have been designated as "outside the flightline" and "inside the flightline." In general, surface soil for "outside the flightline" sites were evaluated based on a future residential exposure scenario. Subsurface soil was either evaluated based on worker exposure scenario or not evaluated based on disposal practices at the site. It should be noted that for some sites, regardless of the level of contamination in subsurface soil, a worker exposure scenario was used for the risk assessment. "Inside the flightline" sites were evaluated based on a worker exposure scenario for both surface and subsurface soil. Based on current land use, restricted access to the base, and land use and management that is strictly controlled by military entities, all remedies/removal actions and no further action decisions are protective in the short term. However, for any source area or exposure pathway (e.g., subsurface soil) within that source area where hazardous substances, pollutants, or contaminants remain or may remain above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable LUCs may be necessary to ensure long-term protectiveness.

3.4.2 Land Use Control Requirement for IRP Source Area Sites Located Outside the Installation Fence Line

All or part of the following IRP source area sites are located outside the installation fence line: SD-1, SD-2, SD-3, SD-4, FS-3, LF-4, and Petroleum Fuels Storage Area [PFSA]/FS-10/FS-11. In general, surface soil for "outside the flightline" sites (which would include these sites) was evaluated based on a future residential exposure scenario. Subsurface soil was either evaluated based on worker exposure scenario or not evaluated based on disposal practices at the site. Furthermore, remedial actions for SD-2, SD-3, and SD-4 were based on ecological risk. Ecological risk-based remedial action levels were much more stringent than human health residential screening levels and MassDEP

S-1/GW-1 standards. LF-4, the only site for which subsurface soil disposal practices would have occurred is a no further action site based on the results of the PA/SI. All implemented remedies and no further action decisions are protective in the short-term based on current land use. However, for any source area or exposure pathway (e.g., subsurface soil) within that source area where hazardous substances, pollutants, or contaminants remain or may remain above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable LUCs may be necessary to ensure long-term protectiveness.

3.5 REFERENCES (SECTIONS 3.0-3.4)

ABB-ES. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation*, Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2003b (January). *Explanation of Significant Differences Areas of Contamination CS-10 (A, B & C); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; and SD-3/FTA-3/CY-4.* Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

ASG. 1993 (January). *Risk Assessment Handbook.* Prepared by Automated Sciences Group, Inc., Hazardous Waste Remedial Actions Program, and Oak Ridge National Laboratory, Oak Ridge Tennessee for ANG Bureau, Massachusetts Military Reservation, Massachusetts.

3.6 SOURCE AREA WRITE-UPS

3.6.1 Chemical Spill No. 1 (CS-1) Source

A. Background

A.1. Site Description. CS-1 includes the former location of four U.S. Army regimental motor pools at Blocks 23, 25, 27, and 29 on North Truck Road (Figure 1-1). The motor pools, active from 1941 to 1946, originally consisted of 11 vehicle maintenance buildings (VMBs) and 11 gas stations. Three gas stations and three VMBs at Block 29 were apparently covered over sometime in the 1950s when the USAF constructed Taxiway Alpha. In the 1991 letter report for the CS-1 sump investigation program (ABB-ES 1991), it was documented that nine underground storage tanks (USTs) were removed from the site between 1985 and 1986, five USTs may have remained in the ground at the east end of CS-1, and five additional USTs at Block 29 may have remained beneath Taxiway Alpha. Other components of CS-1 included 12 catch basins located within the paved motor pool areas, 11 leaching wells associated with the VMBs, and the fenced perimeter areas that received surface runoff from the pavement.

A.2. Initial Response.

Drainage Structure Removal Program: In 1996, 43 of 49 drainage structures and associated VMB foundations, footings, work pits, and associated soils at CS-1 were removed. These removal actions are documented in the DSRP closure report (Jacobs Engineering Group 1996). Six of the remaining structures were assumed to be removed during the Runway Alpha expansion.

Underground Storage Tank Investigation: During the DSRP, a pair of USTs believed to be buried at CS-1 could not be located. In 1997, a ground penetrating radar survey was performed and several small anomalies were detected. An excavation was performed and debris typically associated with USTs was found (i.e., reinforced concrete). It was

concluded that the USTs had been removed at an earlier date (CDM Federal Programs Corporation 1997).

Immediate Response Action: In 1997, an immediate response action (see 310 CMR 40.0410) for the Standard Transmission Corporation Fuel Pipeline was conducted in response to a MassDEP Notice of Responsibility (NOR) to SNG Production Co. regarding a former jet fuel pipeline located in Sandwich, MA. A portion of the pipeline (segment 5A) which is an 890-foot segment running from East Inner Road to the Air Field across Study Area CS-1, passed an integrity test, was pigged, and sealed.

A.3. Basis for Taking Action. Environmental restoration at CS-1 followed the CERCLA site investigation/investigation process. Provided below is a summary of investigations performed at Study Area CS-1.

Preliminary Assessment: The CS-1 study area was identified in the *Phase I: Records Search, Task 6* (E.C. Jordan Co. 1986) as a potential source of contamination based on large quantities of waste oils, solvents, antifreeze, battery electrolyte, paint, kerosene, and fuels that were reportedly generated from vehicle maintenance activities. Additionally, metals were reportedly commingled with these wastes.

Site Inspection: The field program included the 1993 SI, 1995 groundwater confirmational sampling event, and the 1999 confirmational sampling event. Findings of the 1993 and 1995 programs are presented in the final *Site Inspection Report for Study Areas CS-1, CS-2, CS-6/FS-22, FS-26, and FS-27* (CDM Federal Programs Corporation 1996).

The 1993 SI included a magnetometer survey, surface and subsurface soil sampling, and groundwater sampling. Pesticides, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) were detected in surface and subsurface soil. Highest concentrations were found in shallower depths and found primarily within drainage features. Metals were also detected but generally decreased in concentrations with depth.

Inorganics exceeded their respective MCLs in groundwater samples. However, the elevated levels were attributed to suspended particulate matter in groundwater samples.

The purpose of the 1995 confirmation program was to determine the nature and extent of groundwater contaminants identified in the 1993 sampling event. Samples were analyzed for phthalates, pesticides, and inorganics. Thallium was detected in one sample above the MCL, however because it was not detected in soil samples and was detected slightly above the MCL, thallium was not considered a contaminant of concern (COC).

The objective of the 1999 confirmation sampling event was to confirm the presence or absence of organic contamination in groundwater. Nine wells were sampled for VOCs, ethylene dibromide (EDB), and methyl-tert-butyl-ether. Two constituents, chloroform and PCE were detected. Neither of these constituents was detected above their respective MCLs (5 micrograms per liter [μg/L]).

Data from the SI was used to perform a human health PRE for the Study Area CS-1. For surface soil, a Tier I PRE based on occupational worker exposure was performed. No Tier I HECs were exceeded for surface soil. Results of the Tier I human health PRE for subsurface soil (worker exposure scenario) showed HEC exceedances for several polynuclear aromatic hydrocarbons (PAHs); however there was no exceedance for the Tier II human health HEC values. For groundwater, risk based on a future residential exposure scenario was calculated using data from 1995 and 1999 sampling events. Calculated carcinogenic risk was within the EPA target risk range of $1x10^{-4}$ to $1x10^{-6}$. The calculated hazard index was below 1.0.

An ecological PRE was also performed for Study Area CS-1. The ecological PRE indicated that there was potential risk to small mammals from metals and organics in soil. However the risk was considered overestimated because of the quantitative uncertainty analysis with metals (due to elevated risk from background concentrations). Furthermore, site conditions were not amenable to support wildlife.

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area CS-1.

Decision Document: A Decision Document documenting the no further action decision was finalized in September 1999 (AFCEE 1999). The no further action was based on multi-media sampling conducted as part of the SI, the risk analysis for soil and groundwater based on current and anticipated land and groundwater use scenarios, and the removal actions conducted as part of the DSRP.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Study Area CS-1 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action functioning as intended by the decision documents?

Not applicable, no remedial/removal action other than under the DSRP was conducted at Study Area CS-1.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action selection still valid?

Changes in Standards and To-Be Considered: Not applicable, no remedial/removal action other than under the DSRP was conducted at Study Area CS-1.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action decision for Study Area CS-1.

Changes in Toxicity and Other Contaminant Characteristics: There were no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the no further action decision.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., Department of Defense [DoD] and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable LUCs may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable LUCs.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1991 (December). *Completion Letter for Sump Investigation Program, Study Area CS-1*.

AFCEE. 1999 (September). *Design Document for Chemical Spill Site No. 1*. Prepared by HAZWRAP, Portland, Maine, for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

CDM Federal Programs Corporation. 1997 (March). Letter *Report for UST Investigation at CS-1*. Massachusetts Military Reservation, Cape Cod, Massachusetts.

_____. 1996 (August). *Final Site Inspection Report, Study Areas CS-1, CS-2, CS-6/ FS-22, FS-26, and FS-27*. Massachusetts Military Reservation, Cape Cod, Massachusetts.

E.C. Jordan Co., 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6; Installation Restoration Program, Massachusetts Military Reservation*. Prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

Jacobs Engineering, Inc. 1996 (June). *Drainage Structure Removal Program Closure Reports*. Installation Restoration Program, Massachusetts Military Reservation, Otis ANG Base, MA.

3.6.2 Chemical Spill No. 2 USCG (CS-2 USCG) Source

A. Background

A.1. Site Description. Study Area CS-2 USCG consists of the USCG Air Station, which includes two aircraft hangars and support facilities (Figure 1-1). Chemicals potentially released to the environment as a result of maintenance activities at Study Area CS-2 USCG included petroleum, oil, lubricants, solvents, and battery acid.

A.2. Previous Actions.

Dry Well Replacement: A dry well, located west of Building 3162 was replaced in 1992, with another similar storm drain/drywell, in order to improve the drainage characteristics and material condition of the drain. Approximately 20 cubic yards of soil was excavated.

Drainage Structure Removal Program: In 1996, two drainage structures were removed at Study Area CS-2 USCG as part of MMR's DSRP. A dry-well-type leaching structure, 46CDXX2, and a leaching well 46CDXX3 that discharged to 46CDXX2 were removed in April 1996 (Jacobs 1996). Each structure, along with sludge-like material from 46CDXX3 and approximately 118 cubic yards of soil and debris, was excavated and removed. Soil samples were collected from the sides and bottoms of the excavation at each of the removed structures to confirm that concentrations of contaminants were below the DSRP STCLs. The analytical data for the confirmatory samples indicated that the detected concentrations for all samples were below STCLs. The STCL cleanup values used in the closure reports were based on the Tier I HEC values for inside the security zone, which are based on a worker exposure scenario.

Fuel Systems Upgrade Program: On April 6, 1993, an 8,000-gallon fuel UST (current product tank [CPT]-37) was removed from the site. Soils within the tank grave were screened with a photoionization detector (PID), with negative readings for VOCs. The tank appeared to be structurally intact, and no soil staining was observed. The lack of VOCs detected in samples collected from downgradient monitoring wells (MW)-3,

MW-4, and MW-6, also indicate that CPT-37 was not a source of groundwater contamination (AFCEE 2000).

A.3. Basis for Taking Action. Environmental restoration at Study Area CS-2 USCG followed the CERCLA SI process. Provided below is a summary of investigations performed at Study Area CS-2 USCG.

Preliminary Assessment: The CS-2 USCG study area was identified in the *Phase I: Records Search, Task 7* (E.C. Jordan Co. 1986) as a potential site of past uncontrolled disposal of hazardous substances. Chemicals potentially released to the environment as a result of maintenance activities at Study Area CS-2 USCG included petroleum, oil, lubricants, solvents, and battery acid.

Site Inspection: An SI was conducted at Study Area CS-2 USCG in 1993. The initial SI included the collection of 21 surface soil and 14 groundwater samples (ABB-ES 1993). Surface soil samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and inorganics. Groundwater samples were analyzed for VOCs, SVOCs, and inorganics. In 1995, a Supplemental SI (SSI) (ABB-ES 1995) was completed which included three subsurface soil, six surface soil, and two groundwater samples. Subsurface soil samples were analyzed for VOCs, SVOCs, and inorganics. Surface soil samples were analyzed for VOCs, SVOCs, pesticides, PCBs, inorganics, and total petroleum hydrocarbons (TPH). Groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, inorganics, TPH, and EDB. Additional groundwater and sediment sampling was conducted in 1999. Sediment samples were analyzed for extractable petroleum hydrocarbon (EPH)/volatile petroleum hydrocarbon (VPH) and inorganics. Groundwater samples were analyzed for inorganics and EDB. Investigations focused on five areas within Study Area CS-2 USCG. They included:

- area around the leach field northeast of Hanger 3170,
- drainage course east of Hanger 3170,
- area surrounding the Former Barrel Storage Area,

- area surrounding the Former Refueler-Truck Parking Area,
- area downgradient of Building 3162, and
- catch basin between Buildings 3161 and 3162.

Based on results of chemical analysis, concentrations of fuel-related PAHs were present in soil in the drainage course east of Hangar 3170 and in soil around the former refueler truck parking area. The likely source of PAHs in soil east of Hangar 3170 was fuel releases during the operation of USCG Air Station Cape Cod. Fuel spilled on the tarmac and, to a lesser degree, exhaust from plane engines likely contributed most of the detected PAHs in this location. The highest concentrations of PAHs were detected in soil adjacent to a former break in the pavement curbing, which facilitated the runoff of water to the ditch. Lead and copper were consistently detected above MMR background in samples from the drainage course east of Hangar 3170. The concentrations observed are likely a combination of background and non-point sources. These analytes were likely transported from areas including the tarmac by precipitation runoff.

Groundwater chemical analysis results indicate minimal impact from Study Area CS-2 USCG activities. Elevated concentrations of beryllium and manganese were detected in one monitoring well (MW-6). The concentration of manganese in groundwater was likely due to temporary reducing conditions. Manganese is naturally prevalent in the subsurface strata at the MMR, and has been shown to solubilize under similar conditions (AFCEE 2000). SVOCs, pesticides, and PCBs were not detected in any samples.

Data from the SI was used to perform a human health PRE for Study Area CS-2 USCG. For surface soil and subsurface soil, a Tier I PRE based on a worker exposure scenario was performed. No Tier I HECs were exceeded. For groundwater, maximum concentrations of analytes were compared to PRE Tier I HECs (residential exposure scenario) and to available MCLs. Several analytes exceeded PRE Tier I HECs; however concentrations were lower than Tier II HECs.

An ecological PRE was also performed for Study Area CS-2 USCG. Although the ecological PRE indicated that maximum concentrations of several inorganics exceeded the benchmarks for phytotoxicity and invertebrates; adverse effect to the community structure of both plants and invertebrates is unlikely due to concentration of the inorganics being slightly higher than the background range for soil in Massachusetts. It is unlikely that the food source of insectivores and omnivores would be adversely affected due to the relatively small areas of elevated concentrations and the abundant alternative foraging areas nearby.

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area CS-2 USCG.

Decision Document: A Decision Document documenting the no further action decision was finalized in November 2000 (AFCEE 2000). The no further action was based on multi-media sampling conducted as part of the SI; the results of the HHRA for soil and groundwater based on current and anticipated land and groundwater use scenarios; and results of the ecological risk analysis. Furthermore, contaminated substructures and associated soils were removed as part of the DSRP and the Fuel Systems Upgrade Program (FSUP).

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Study Area CS-2 USCG was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action functioning as intended by the decision documents?

Not applicable, no remedial/removal action was conducted at Study Area CS-2 USCG. However, drainage structures were removed as part of the DSRP and an UST was removed as part of the FSUP.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action selection still valid?

Changes in Standards and To-Be Considered: Not applicable, no remedial/removal action other than under the DSRP was conducted at Study Area CS-2 USCG.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action decision for Study Area CS-2 USCG.

Changes in Toxicity and Other Contaminant Characteristics: There were no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the no further action decision.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable LUCs may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable LUCs.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1995 (October). "*Draft Supplemental Sampling Report Priority 2 and 3 SI Study Areas.*" IRP/MMR. Prepared by ABB Environmental Services for Hazardous Waste Remedial Actions Program, Portland, Maine.

_____. 1993 (October). Priority *2 and 3 Study Areas Site Investigation; IRP/MMR*. Prepared by ABB Environmental Services for Hazardous Waste Remedial Actions Program; Portland Maine.

AFCEE. 2000 (November). *Decision Document of U.S. Coast Guard Chemical Spill No. 2 [CS-2 USCG] Study Area.* Prepared by AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6*; Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

Jacobs. 1996 (August). *Drainage Structure Removal Program Closure Reports 03CDXX1, 09CDXX2, 29CDXX1, 46CSXX2, and 46CSXX3.* Installation Restoration Program, Massachusetts Military Reservation, Otis ANG Base, MA.

3.6.3 Chemical Spill No. 4 (CS-4) Source

A. Background

A.1. Site Description. AOC CS-4 West Truck Road Motor Pool (Source) is divided into northern and southern portions. The southern source area is the southwestern section of West Truck Road and Gaffney Road, which was the former motor pool and Defense Property Disposal Office (DPDO) yard. The northern study area is located at the northern end of AOC CS-4, at the northeast intersection of West Truck Road and Gaffney Road. The study area includes a former gasoline station, a former bus terminal, a suspected waste disposal pit, piles of sand and debris, a wetland, and two areas that receive storm-water runoff (Figure 1-1).

Groundwater contamination was found to consist of a chlorinated solvent plume migrating downgradient from CS-4 in a south-southwest direction. As a result of investigations, CS-4 was subdivided into soil and groundwater operable units. The CS-4 groundwater operable unit is being addressed as part of the remedial process for the Southwest Operable Unit (SWOU).

A.2. Initial Response.

Drainage Structure Removal Program: Twenty-four drainage structures were removed as part of the DSRP in 1996.

A.3. Basis for Taking Action. Environmental restoration at AOC CS-4 Source followed the CERCLA non-time critical removal action process. Provided below is a summary of investigations performed at AOC CS-4 Source.

Preliminary Assessment: In 1986, the IRP Phase I Records Search (Task 6) to identify sites at MMR indicated the need for further investigation at CS-4. According to the PA, military vehicles were maintained at this study area by the U.S. Army from 1940 to 1946 and by the USAF from 1955 to 1973. Wastes generated and potentially spilled or

dumped during this period include oils, solvents, antifreeze, battery electrolytes, paint, and waste fuels. Between 1965 and 1983, the DPDO maintained a storage yard in the northern portion of AOC CS-4 Source. Wastes and equipment handled included transformers, electrical equipment, waste oils, solvents, and waste fuels.

Sampling Investigations (Southern Source Area): As a result of sampling investigations conducted by the Army Environmental Hygiene Agency (in 1986) and E. C. Jordan Company (in 1988), soil and groundwater contamination was found in the southern portion of the CS-4 site. Field observations and analytical results obtained for soil and sediments sampled at the study area show that contamination was generally limited to petroleum-related and chlorinated solvent releases found in surface and shallow subsurface soil in the vicinity of the former USTs/soil piles at the gas station/DPDO yard, at the waste disposal pit, and in the sediments at the northern drainage swale. TPH levels exceeding the proposed MMR STCL of 1,200 mg/kg were found in the surface and subsurface soil at the former gas station and waste disposal pit and in the sediments of the northern drainage swale.

SSI (Northern Source Area): An SSI was completed by in 1996 by Advanced Sciences Incorporated (ASI). The SSI consisted of four surface soil samples collected from a low-lying depression within the northern source area. Samples were analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, TCL Pesticides/PCBs, TPH, and TAL Inorganics. Sample SS-01 contained COCs above RALs [i.e., lead (933 mg/kg) and TPH (2,100 mg/kg)]. Sample SS-02 contained zinc (101 mg/kg) above the RAL. Sample SS-03 contained lead (102 mg/kg) and zinc (158 mg/kg) above the RAL. Sample SS-04 did not contain COCs above RALs.

In 1999, additional SSI activities were conducted in the northern portion of the study area at the drainage swale along Connery Avenue. Samples were analyzed for EPH/VPH. None of the samples exceeded the MassDEP S-1/GW-1 standards for EPH/VPH. At the former gas station near the oil-stained soil piles, five subsurface soil samples were

collected and analyzed for EPH/VPH and TCL VOCs. Chlorinated VOCs were detected in all five samples. Elevated concentrations of EPH/VPH were also detected.

A human health PRE based on a residential exposure scenario was completed as part of the SSI. The human health COCs selected were lead, Aroclor 1260, and EPH/VPH. An ecological PRE was completed to evaluate potential ecological risks associated with exposure to surface soil. The ecological COCs identified were lead, zinc, 4,4'DDE, 4,4'DDT, and dieldrin. Results of the PRE triggered the need for an evaluation of removal action alternatives (i.e., EE/CA).

Engineering Evaluation/Cost Analysis (Southern Source Area): An Engineering Evaluation/Cost Analysis (EE/CA) was completed for the southern source area in June 1991 (AFCEE 1991). The following alternatives received detailed analysis in the EE/CA.

- Land Treatment and Off-site Incineration
- Thermal Treatment

Engineering Evaluation/Cost Analysis (Northern Source Area): An EE/CA was completed for the northern source area in October 2001 (AFCEE 2001a).

The following alternative received detailed analysis in the EE/CA:

- Excavation, Off-site Disposal and Site Restoration

B. Remedial/Removal Actions

This section presents the regulatory actions, remedial/removal objectives (RAOs), a description of the selected remedy, and a summary of the removal action implementation at AOC CS-4 Source.

B.1. Regulatory Actions. Provided below are the controlling documents that present the selected removal actions.

Action Memorandum (Southern Source Area): Based on information presented in the June 1991 EE/CA, the selected removal action alternative was Alternative Two, excavation and thermal treatment of AOC soil. The decision was documented in an Action Memorandum (AM) (ABB-ES 1992). Approximately 3,000 cubic yards of soil contaminated with COCs above the RALs would be excavated from the site and transported to the FTA-1 mobile thermal treatment unit for treatment.

Action Memorandum (Northern Source Area): One action was presented in the October 2001 EE/CA. This action consists of excavating an estimated 1,830 cubic yards of soil contaminated with COCs above the RALs; segregation based on whether or not the soil is hazardous as defined by the Resource Conservation and Recovery Act; and staging the soil for off-site transportation to an appropriately licensed landfill for disposal (AFCEE 2002).

B.2. Removal Action Objectives. The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The following RAOs were established for AOC CS-4 Northern Source Area:

- Protect ecological and human receptors by mitigating direct exposure to soil contaminated with lead, zinc, and pesticides which may pose unacceptable risk.
- Protect groundwater from the leaching of petroleum related-contaminants from soil.

The following RAOs were established for AOC CS-4 Southern Source Area:

- Remove 3,000 cy of soil from the CS-4 Study Area to eliminate sources of groundwater contamination.

Presented in Tables B-1 and B-2 are (1) the RALs that must be achieved to meet remedial response objectives for CS-4, and (2) the MassDEP EPH/VPH standards, respectively.

Table B-1
CS-4 COCs and Respective RALs

COC	Risk Based Criteria	RAL (mg/kg)
Lead	Ecological	99
	Human Health	300
Zinc	Ecological	68
Aroclor 1260	Human Health	1.0
4,4'DDE	Ecological	0.227
4,4'DDT	Ecological	0.25
Dieldrin	Ecological	0.035
TPHs	Human Health	200

Table B-2
MassDEP EPH/VPH Standards

Analytes		MassDEP S-1/GW-1 Standards (0-15 ft bgs) (mg/kg)	MassDEP S-3/GW-1 Standards (>15 ft bgs) (mg/kg)
EPH	C9-C18 Aliphatic Hydrocarbons	1,000	5,000
	C19-C36 Aliphatic Hydrocarbons	2,500	5,000
	C11-C22 Aromatic Hydrocarbons	200	200
VPH	C5-C8 Aliphatic Hydrocarbons	100	500
	C9-C12 Aliphatic Hydrocarbons	1,000	5,000
	C9-C10 Aromatic Hydrocarbons	100	100

B.3. Removal Action Implementation

Southern Source Area: Treatment of contaminated soil at the FTA-1 Thermal Treatment Unit began in June 1995. Approximately 3,000 cubic yards of soil excavated from the CS-4 southern source area was combined with approximately 49,000 tons of soil at the FTA-1 site in 1996. Soil treatment was delayed in 1997 as a result of a fire on February 26, 1997. Thermal treatment resumed on June 30, 1997 and was completed on September 8, 1997. The FTA-1 Closure Report was completed for the removal action (AFCEE 2000).

Northern Source Area: AFCEE conducted removal activities in 2002 at the northern source area. Approximately 2,000 cubic yards of contaminated soil were excavated. During excavation activities, a UST was discovered and removed. Excavated soil was transported to a central bulking facility located on the MMR. Consolidated soil was disposed of at the North Carver Landfill in North Carver Massachusetts, and at the Thatcher Street landfill in Brockton Massachusetts. Disposal activities were performed in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MassDEP 1997). The removal action was documented in a Removal Action Report completed in 2005 (AFCEE 2005).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- CS-4 Removal Action Report: Completed September 2005
- AOC CS-4 Source was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The removal actions have been completed and are functioning as intended by the AM.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: MassDEP has re-evaluated S-1/GW-1 soil standards since the finalization of the AMs and implementation of the removal actions at AOC CS-4 Source. The new S-1/GW-1 soil standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. No cleanup levels for chemical compounds identified as COCs decreased numerically during this five-year period. The new MassDEP S-1/GW-1 soil standards do not change the protectiveness of the implemented removal action.

<u>Changes in Exposure Pathways</u>: There have been no changes in the physical conditions or exposure pathways that would affect the protectiveness of the removal action.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: MassDEP has re-evaluated S-1/GW-1 standards for EPH/VPH since the last five-year review. The MassDEP S-1/GW-1 standards are based on unrestricted use and take into consideration dermal exposure, ingestion exposure, and impact to groundwater. The new MassDEP S-1/GW-1 soil standards do not change the protectiveness of the implemented removal action.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the implemented removal action.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no information that calls into question of the protectiveness of the selected removal actions.

E. Issues

None.

F. Recommendations and Follow-Up Actions

None.

G. Protectiveness Statement

The no further action decision for this site protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing concentrations of COCs above RALs has been removed. No land-use restrictions are required for the site and the site no longer requires a five-year review

H. References

ABB-ES. 1992 (August). *Action Memorandum AOCs CS-4, FS-25, & FTA-1 Source Removal*; Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2005 (September). *Chemical Spill 4 (CS-4) Removal Action Report.* Prepared by Engineering Strategies Corporation and Portage Environmental Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2002 (January). *Chemical Spill No. 4 (CS-4) Action Memorandum (AM)).* Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2001a (October). *Chemical Spill No. 4 (CS-4) Engineering Evaluation/Cost Analysis (EE/CA)*. Prepared by Engineering Strategies Corporation and Universe Technologies for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2001b (May). *Supplemental Site Inspection report Area of Contamination CS-4 Source Operable Unit.* Prepared by Advanced Infrastructure Management Technologies for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2000 (July). *Final Closure Report FTA-1 Site.* Installation Restoration Program, Massachusetts Military Reservation. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 1991 (June). *Engineering Evaluation/Cost Analysis CS-4, FS-25, and FTA-1 Study Areas Removal Action.* Prepared by ABB Environmental Services, Portland Maine, for Installation Restoration Program, Massachusetts Military Reservation, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

MassDEP. 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection.

3.6.4 Chemical Spill No. 4 USCG (CS-4 USCG)/Fuel Spill No. 1 USCG (FS-1 USCG) Source

A. Background

A.1. Site Description. AOC CS-4 USCG/FS-1 USCG is approximately 11.5 acres, and is located on Riley Street in the ANG section of MMR and includes the area around Hangar 128 (Figure 1-1).

From 1955 until 1970, Hangar 128 was used to maintain aircraft owned by the USAF. During this time, unknown quantities of solvents were flushed into the storm drainage system. Expansion and contraction of fuel-filling wing tanks in the hangar resulted in numerous spills of aviation gasoline (AVGAS) on the hangar deck. From 1976 to 1988, Hangar 128 was used by the USCG to maintain fixed-wing aircraft. Wastes generated at the hangar during this period included waste oils and solvents. These chemicals reportedly were spilled periodically inside and outside the hangar.

A.2. Initial Response.

Drainage Structure Removal Program: During the DSRP, an acid pit was identified on the western side of the hangar. The pit was reportedly sealed in 1995.

A.3. Basis for Taking Action. Environmental restoration at AOC CS-4 USCG/FS-1 USCG followed the CERCLA non-time critical removal action process. Provided below is a summary of investigations performed at AOC CS-4 USCG/FS-1 USCG.

Preliminary Assessment: Hangar 128 was first identified in the Task 6 records search as a potential source of contaminants contributing to AOC SD-4. Additional evaluation of AOC CS-4 USCG/FS-1 USCG was conducted during the Task 7 records search (E.C. Jordan Co. 1986). Disposal of solvents and petroleum-based oils and lubricants (POLs) onto the hangar floor and infiltration through floor joints was cited as a source of

potential contaminant release. In addition, two fuel spills were documented on the northern side of the hangar.

Site Investigation: A SI was completed in October 1993 intended to determine the nature and extent of contamination at AOC CS-4 USCG/FS-1 USCG (ABB-ES 1993). The SI was conducted in three phases. Phase I included surface soil, subsurface soil sampling (>15 ft bgs), and groundwater sampling. Phases II and III included the sampling of groundwater. Surface soil samples were analyzed for PCBs, pesticides, VOCs, SVOCs, and inorganics. Deep subsurface soil and groundwater samples were analyzed for VOCs, SVOCs, and inorganics. PAHs and several inorganics were detected in surface soil. VOCs, PCBs, and pesticides were not detected in surface soil. TCL VOCs and SVOCs were not detected in groundwater samples collected from the AOC. Iron was detected at a concentration above background in groundwater.

Supplemental Sampling Investigation: After review of the Draft Priority 2 and 3 Study Areas SI Report, the National Guard Bureau (NGB) and regulatory agencies (i.e., EPA and MassDEP) agreed that additional exploration and sampling would be appropriate at the AOC.

An SSI was completed in 1995 on the eastern side of the taxiway, on the northern side of the hangar, and on the perimeter of the parking area south of the hangar, and on the acid leaching pit located in this AOC (ABB-ES 1995). Sampling identified an area of soil contaminated with PAHs, lead, and chromium east of the taxiway on the northern side of Hangar 128 and on the perimeter of the parking area on the southern side of the building. Contamination was not identified in soil samples collected from below the acid leaching pit. A round of groundwater samples also was collected from monitoring wells during the SSI and analyzed for EDB, VOCs, SVOCs, and PCB/pesticides. No constituents exceeded MCLs.

A PRE based on a utility worker exposure scenario and an ecological PRE were conducted for AOC CS-4 USCG/FS-1 USCG surface soil. Groundwater was evaluated based on residential exposure scenario. The PRE was updated in 1995 to incorporate the supplemental sampling data. Soil COCs identified as a result of the PRE included PAHs and inorganics (Table B-1). No groundwater COCs were identified.

Engineering Evaluation/Cost Analysis: AOC CS-4 USCG/FS-1 USCG was included as part of the Priority 2 and 3 Study Areas and Drum Disposal Operable Unit (DDOU) EE/CA completed in October 1998 (AFCEE 1998). The following alternatives received detailed analysis in the EE/CA:

- Alternative 1: On-base Thermal Desorption and Off-base Treatment and Disposal;
- Alternative 2: On-base Asphalt Batching and Off-base Treatment and Disposal;
- Alternative 3: Off-base Treatment and/or Disposal.

B. Removal Actions

This section presents the regulatory actions, RAOs, a description of the selected removal action, and a summary of the removal action implementation at AOC CS-4 USCG/FS-1 USCG.

B.1. Regulatory Actions. Provided below are controlling documents that present the selected removal action and post-AM documents that identified changes to the selected removal action.

Action Memorandum: The Priority 2 and 3 Study Areas and DDOU Source Removal AM (AFCEE 1999) was prepared to document the decision to perform removal actions at several Priority 2 and 3 Study Areas including CS-4 USCG/FS-1 USCG. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 2 which included excavating AOC CS-4 USCG/FS-1 USCG soil and

treating the excavated material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility.

Action Memorandum Addendum: An AM Addendum for Priority 2 and 3 Study Areas and DDOU Source Removal (AFCEE 2003) was prepared to document changes to the selected removal action for AOC CS-4 USCG/FS-1 USCG. The changes included: (1) establishment of RALs for certain inorganic chemicals; (2) removal of the asphalt-batching component from the selected removal action; and (3) the expansion of offsite disposal options to include Resource Conservation and Recovery Act (RCRA) Subtitle D facilities.

B.2. Removal Action Objectives. The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. Risk evaluations conducted at AOC CS-4 USCG/FS-1 USCG demonstrate that surface soil contaminated with PAHs and inorganics may pose unacceptable risk to humans and ecological receptors under current exposure scenarios. STCLs used for the DSRP (HAZWRAP 1996) were retained and used to develop cleanup levels for identified COCs. In 2000, AFCEE with concurrence from EPA and MassDEP revised ecological risk-based STCLs for inorganic chemicals in a technical memorandum (AFCEE 2000). In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the STCL technical memorandum (AFCEE 2002).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background. Development and establishment of RALs were documented in the AM Addendum prepared in 2003 (AFCEE 2003). Presented in Table B-1 are RALs that must be achieved to meet removal response objectives for CS-4 USCG/FS-1 USCG.

Table B-1 COCs and RALs for CS-4 USCG/FS-1 USCG		
COC	**Basis**	**RAL (mg/kg)**
Arsenic	Ecological	7.1
Cadmium	Ecological	1.8
Chromium	Background	19
Lead	Ecological	99
Zinc	Ecological	68
Benzo(b)fluoranthene	Ecological	5 Total cPAH
Benzo(k)fluoranthene	Ecological	5 Total cPAH
Benzo(a)pyrene	Ecological	5 Total cPAH
Indeno(1,2,3,-cd)pyrene	Ecological	5 Total cPAH
Dibenz(a,h)anthracene	Ecological	5 Total cPAH
Benzo(g,h,i)perylene	Ecological	5 Total cPAH
Benzo(a)ahthracene	Ecological	5 Total cPAH
Chrysene	Ecological	0.625
Phenanthrene	Ecological	0.625
Fluoranthene	Ecological	7.81
Pyrene	Ecological	4.59

Note: cPAH = polycyclic aromatic hydrocarbon

B.3. Removal Action Description. Using the AM and the AM Addendum as described in Section B.1 as the procedures for removal action implementation, the removal action would consist of excavating contaminated surface soil at AOC CS-4 USCG/FS-1 USCG. Excavated soil would be transported to an on-base central bulking facility for waste characterization. Excavated soil determined to exceed the toxicity characteristic leaching procedure (TCLP) allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA Subtitle C Treatment Storage and/or Disposal Facility (TSDF). Soil determined to be below TCLP allowable concentrations and therefore

nonhazardous (and that are determined to contain contaminant concentrations below MassDEP Massachusetts Contingency Plan (MCP) Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling facility Summary Levels) would be transported offsite to a Subtitle D facility. Post-excavation confirmatory sampling would be conducted to ensure that all soil with COC concentrations exceed CS-4 USCG/FS-1 USCG soil cleanup levels was removed.

B.4 Removal Action Implementation. AFCEE conducted removal activities at CS-4 USCG/FS-1 USCG in 2001. Approximately 300 cubic yards of contaminated soil were excavated from CS-4 USCG/FS-1 USCG and combined with soil excavated from other SARAP sites with similar disposal requirements. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. CS-4 USCG/FS-1 USCG soil was disposed of at the Taunton Landfill in Massachusetts, in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MassDEP 1997).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- Final Priority 2 and 3 Study Areas and DDOU Removal Action Report: Completed in April 2004 (AFCEE 2004).
- Study Area CS-4 (USCG)/FS-1 (USCG) was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the removal action functioning as intended by the decision documents?

The review of documents, applicable or relevant and appropriate requirements (ARARs), risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the AM modified by the AM Addendum.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

Changes in Standards and To-Be Considered: There have been changes in chemical-specific ARARs. MassDEP has re-evaluated S-1/GW-1 and S-2/GW-1 standards since the last five-year review. The new S-1/GW-1 and S-2/GW-1 standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. All of the COCs have chemical-specific MassDEP S-1/GW-1 and S-2/GW-1 standards. Nine of the 11 PAHs have MassDEP S-1/GW-1 standards that are less stringent that the cleanup standards used for the removal action. However, benzo(a)pyrene and dibenz(a,h)anthracene have S-1/GW-1 and S-2/GW-1 standards lower than the maximum allowable combined concentrations for the carcinogenic seven PAHs (Table B-1). The new MassDEP S-1/GW-1 and/or S-2/GW-1 standards for benzo(a)pyrene and dibenz(a,h)anthracene could potentially affect the protectiveness of the implemented removal action.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics: MassDEP soil standards have changed for the COCs identified for AOC CS-4 USCG/ FS-1 USCG. Please refer to the section discussing change in cleanup standards.

Changes in Risk Assessment Methods: MassDEP soil standards have changed for the COCs identified for AOC CS-4 USCG/FS-1 USCG. Please refer to the section discussing change in cleanup standards.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the removal action based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The implemented removal action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable LUCs may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

(1) As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable LUCs.

(2) The new MassDEP soil standards for benzo(a)pyrene and dibenz(a,h)anthracene could potentially affect the protectiveness of the removal action.

F. Recommendations

(1) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and

unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

(2) MassDEP S-1/GW-1 and S-2/GW-1 standards for benzo(a)pyrene and dibenz(a,h)anthracene are more stringent than those used for the removal action. AFCEE shall determine if the new standard is applicable. Site characterization, delineation data, and confirmation data needs to re-evaluated to determine protectiveness of the removal action, and whether any further action is required.

G. Protectiveness Statement

The removal action conducted for the AOC CS-4 USCG/FS-1 USCG (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing COCs above RALs has been removed. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1995. *Supplemental Sampling Report for Priority 2 and 3 Study Areas Sites*; Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

_____. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation*, Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2004 (April). *Final Removal Action Report Priority 2 and 3 Study Areas and Drum Disposal Operable Unit.* Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2003 (February). *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2002 (September). *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2000 (December). *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1999 June. *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal.* Prepared for AFCEE/MMR Installation Restoration Program by HAZWRAP, Oakridge, Tennessee.

_____. 1998 (October). *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis.* Prepared for AFCEE/MMR Installation Restoration Program by HAZWRAP, Portland, Maine.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, U.S. Coast Guard Facilities at Massachusetts Military Reservation, Task 7.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

HAZWRAP. 1996 (January). *Soil Target Cleanup Levels, DSRP.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for AFCEE/MMR.

MassDEP. 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection.

3.6.5 Chemical Spill-5 (CS-5) Source

A. Background

A.1. Site Description. AOC CS-5 is approximately 4.5 acres, and is located adjacent to Building 3461 at the intersection of Weaver Road and Beaman Road on the MMR (Figure 1-1).

AOC CS-5 was evaluated as part of the Task 6 Records Search (E.C. Jordan Co. 1986). According to the records search, Building 3461 was used by the U.S. Army as a weapons repair shop from 1941 to 1946. From 1955 to 1967, the USAF used the area as a refueler maintenance shop and a spray paint shop. Waste oil, solvents, paints, battery acid, and antifreeze may have been disposed on site. During this time, 5,000-gallon refueler trucks were routinely emptied of up to 1,000 gallons of fuel, which was potentially disposed on the ground at the AOC. In addition, undocumented quantities of AVGAS and Jet Fuel-4 (JP-4) were reportedly disposed of on the ground when filters were changed on the refueling trucks. The AOC is believed to have been used as a salvage yard during some period of operation.

A.2. Initial Response.

Drainage Structure Removal Program**:** As part of the DSRP, a removal action was completed at AOC CS-5 in 1996. An oil interceptor was removed and a sump was decontaminated and abandoned in place (i.e., filled with concrete).

A.3. Basis for Taking Action. Environmental restoration at CS-5 followed the CERCLA non-time critical removal action process. Provided below is a summary of investigations performed at AOC CS-5.

Site Investigation: An SI was completed in October 1993 (ABB-ES 1993). The SI consisted of three phases. Phase 1 consisted of the installation and sampling of one monitoring well for TCL VOC analyses and the collection of 16 surface soil samples and

two subsurface soil samples. Phase 2 consisted of the installation and sampling of three monitoring wells and the collection of sediment samples from the two underground structures located at CS-5. Samples were collected and screened for targeted VOCs. Finally, an oil and water sample from the sump located inside Building 3461 was analyzed. During Phase 3, five test pits were completed for the purpose of collecting additional soil samples for analysis because previous samples had exceeded their holding times. During the three phases of the field investigation, ten groundwater samples were collected and analyzed for TCL VOCs.

The two underground structures associated with Building 3461 were found to contain elevated concentrations of contaminants. Certain areas of surface soil at AOC CS-5 were found to have been impacted by previous uses of the area. Contaminants, in particular PAHs and lead (up to 7,650 mg/kg) as well as several other analytes were sporadically detected in surface soil. Subsurface soil samples collected during the three phases generally showed considerably lower concentrations of contaminants than the surface soil. These concentrations are consistent with the study area history of spills on the surface. It should be noted that many of the sample locations were below weathered pavement, which may be contributing to the reported PAH concentrations. Groundwater samples from four wells were within regulatory standards, with only one slight exceedance that was not verified during a subsequent sampling event.

As part of the SI, PRE and PRA calculations were completed for surface and subsurface soil for current and future human health scenarios. Surface soil was evaluated for future human health residential and ecological exposure scenarios. Subsurface soil risk evaluation was based on non-residential exposure pathways (e.g., trespasser, worker, etc.).

Results of the ecological risk assessment (ERA) and HHRAs triggered the need for an alternative evaluation. COCs identified at AOC CS-5 included lead, TPH, and arochlor 1242.

Engineering Evaluation/Cost Analysis: AOC CS-5 was included as part of the Priority 2 and 3 Study Areas and DDOU EE/CA completed in October 1998 (AFCEE 1998).

The following alternatives received detailed analysis in the EE/CA:

- Alternative 1: On-base Thermal Desorption and Off-base Treatment and Disposal
- Alternative 2: On-base Asphalt Batching and Off-base Treatment and Disposal
- Alternative 3: Off-base Treatment and/or Disposal

B. Removal Actions

This section presents the regulatory actions, RAOs, a description of the selected removal action, and a summary of the removal action implementation at AOC CS-5.

B.1. Regulatory Actions. Described below are controlling documents that present the selected removal action and post-AM documents that identified changes to the selected removal action.

Action Memorandum: The Priority 2 and 3 Study Areas and DDOU Source Removal AM (AFCEE 1999) was prepared to document the decision to perform removal actions at several Priority 2 and 3 Study Areas including CS-5. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative Two which included excavating AOC CS-5 soil and treating the excavated material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility.

Action Memorandum Addendum: Priority 2 and 3 Study Areas and DDOU Source Removal AM Addendum (AFCEE 2003) was prepared to document changes to the selected removal action for several sites in the SARAP including CS-5. Three changes were made to the selected removal action presented in the Priority 2 and 3 Study Areas EE/CA: (1) establishment of RALs for certain inorganic chemicals and PCBs;

(2) removal of the asphalt-batching component from the selected removal action; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2. Removal Action Objectives. The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The human health risk evaluation and ecological risk evaluation conducted as part of the SI indicated that Aroclor-1242 and lead concentrations in surface soil posed unacceptable risk to humans (under future residential exposure scenario) and ecological receptors. Elevated levels of TPH were also present in surface soil at this study area.

MMR-STCLs used for the DSRP (AFCEE 1996) were retained and used to develop cleanup levels for identified COCs. In 2000, AFCEE with concurrence from EPA and MassDEP revised ecological risk-based STCLs for inorganic chemicals in a technical memorandum (AFCEE 2000). In addition, AFCEE used EPA screening level guidance for Superfund sites as the RAL for PCBs (AFCEE 2003). In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the STCL technical memorandum (AFCEE 2002). The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs were documented in an AM Addendum prepared in 2002 (AFCEE 2003). Furthermore, the TPH cleanup level was replaced by MassDEP S-1/GW-1 standards for EPH and VPH. Presented in Table B-1 and Table B-2 are RALs that must be achieved to meet remedial response objectives for CS-5.

Table B-1 COCs and RALs for CS-5		
COC	**Basis**	**RAL (mg/kg)**
Lead	Ecological	99
TPHs	MCP	See Table B-2
Arochlor 1242	Human	1

Table B-2 MassDEP S-1/GW-1 Standards for Petroleum Hydrocarbons	
Type of Petroleum Hydrocarbons	**RAL (mg/kg)**
Aliphatic Hydrocarbons	
C_5 through C_8 Aliphatic Hydrocarbons	100
C_9 through C_{12} Aliphatic Hydrocarbons	1,000
C_9 through C_{18} Aliphatic Hydrocarbons	1,000
C_{19} through C_{36} Aliphatic Hydrocarbons	2,500
Aromatic Hydrocarbons	
C_9 through C_{10} Aromatic Hydrocarbons	100
C_{11} through C_{22} Aromatic Hydrocarbons	200

B.3. Removal Action Description. Using the AM and AM Addendum as described in Section B.1 as the procedures for removal action implementation, the removal action consisted of excavating contaminated surface soil at CS-5. Excavated soil determined to exceed TCLP allowable concentrations and therefore deemed hazardous would be

disposed off-site in a RCRA Subtitle C TSDF. Soil that was determined to be below TCLP allowable concentrations and therefore nonhazardous (and that was determined to contain contaminant concentrations below MassDEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be transported offsite to a Subtitle D facility. Post-excavation confirmatory sampling would be conducted to ensure that all soil with COC concentrations exceeding CS-5 soil cleanup levels was removed.

B.4 Removal Action Implementation . AFCEE conducted removal activities at CS-5 in 2002. Approximately 86 cubic yards of contaminated soil was excavated from CS-5 and combined with soil excavated from other SARAP sites with similar disposal requirements. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. CS-5 soil was disposed of at the Taunton Landfill in Massachusetts, in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MassDEP 1997).

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Final Priority 2 and 3 Study Areas and DDOU Removal Action Report: Completed in April 2004 (April 2004).
- AOC CS-5 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the AM modified by the AM Addendum.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

Changes in Standards and To-Be Considered: There have been changes in chemical-specific ARARs. MassDEP has re-evaluated S-1/GW-1 standards since the last five-year review. The new S-1/GW-1 standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. The MassDEP S-1/GW-1 standard for C_{19} through C_{36} aliphatic hydrocarbons has increased from 2,500 mg/kg to 3,000 mg/kg. The MassDEP S-1/GW-1 standard for C_{11} through C_{22} aromatic hydrocarbons has increased from 200 mg/kg to 1,000 mg/kg. The new MassDEP S-1/GW-1 standards do not change the protectiveness of the implemented removal action.

Changes in Exposure Pathways*:* There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics: Ecological risk-based RALs were calculated using toxicity information available in 2000 which are presented in a technical memorandum (AFCEE 2000). The CS-5 removal action completed in 2002 was based partly on these ecological risk-based RALs. No changes in toxicity and/or contaminant characteristics triggered the need to reevaluate ecological risk-based RALs.

Changes in Risk Assessment Methods: The removal action was completed in 2001. There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the implemented removal action.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or U.S. Geological Survey (USGS) land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable LUCs may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable LUCs.

F. Recommendations and Follow-Up Actions

(1) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

(2) MassDEP S-1/GW-1 standards for EPH/VPH have changed. AFCEE shall determine if the new standard is applicable.

G. Protectiveness Statement

The removal action selected for the AOC CS-5 (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing COCs above RALs have been removed. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness. There have been changes in the MassDEP S-1/GW-1 standards for EPH/VPH; however, the removal action remains protective.

H. References

ABB-ES. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation*, Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2004 (April). *Final Removal Action Report Priority 2 and 3 Study Areas and Drum Disposal Unit Source Area*. Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis, ANG Base, MA.

_____. 2003 (February). *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis, ANG Base, MA.

_____. 2002 (September). *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels for Inorganics*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis, ANG Base, MA.

_____. 2000 (December). *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels for Inorganics.* Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis, ANG Base, MA.

_____. 1999 (June). *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal*. Prepared by Harding Lawson Associates (HLA) for AFCEE/MMR Installation Restoration Program, Otis, ANG Base, MA.

_____. 1998 (October). *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis.* Prepared by HLA for AFCEE/MMR Installation Restoration Program, Otis, ANG Base, MA.

_____. 1996 (January). *Soil Target Cleanup Levels, DSRP*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis, ANG Base, MA.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6*; Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

MassDEP. 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection.

3.6.6 Chemical Spill No. 6 (CS-6)/Fuel Spill No. 22 (FS-22) Source

A. Background

A.1. Site Description. Study Area CS-6/FS-22 includes Building 754 and the area immediately around Building 754, which has been used as a vehicle maintenance shop since 1967 (Figure 1-1). Study Area CS-6 structures and site features functioned as three waste discharge points including a former oil/water separator (OWS), a companion leaching well, and paved areas draining to the drainage structures or site perimeters. Study Area FS-22 is a drainage ditch located south of, and adjacent to CS-6, where, in 1984, a 4,500-gallon fuel spill resulted in a discharge of fuel to the drainage ditch. The discharge was contained within the drainage ditch. All free products were removed from the ditch, and visibly contaminated soil was excavated.

A.2. Initial Response.

Oil/Water Separator Conversion: In 1989, a new subsurface OWS was installed. The old OWS (Structure 26CDXX1) was converted to a diversion manhole for piping connecting floor drains in Building 754 to the new OWS. The new OWS discharges to a sanitary sewer. In 1999, a site visit by AFCEE confirmed that the piping connection between the old OWS and its associated leaching well (Structure 26CDXX2) were properly sealed and that the leaching well was filled with sand.

Sump Removal Action Program: Soil adjacent and beneath the old OWS (Structure 26CDXX1) was sampled and analyzed for VOCs, SVOCs, pesticides/PCBs, TPH, and inorganics. VOCs, SVOCs, pesticides/PCBs were not detected. Samples contained levels of TPH and inorganics, but all values were below STCLs. Details of the investigation are provided in the Phase I Sump Removal Program Work Completion Report (HAZWRAP 1992).

Sediment from the leaching well associated with the OWS was sampled. All contaminant concentrations were below STCLs. Soil adjacent and beneath the leaching well were

sampled and analyzed for VOCs, SVOCs, pesticides/PCBs, TPH, and inorganics. VOCs, SVOCs, and PCBs were not detected. Samples contained levels of TPH and inorganics, but all values were below STCLs.

Because no significant contamination was identified in adjacent soils and groundwater immediately downgradient of the old OWS (structure 26CDXX1) and associated leaching well (structure 26CDXX2), these were not removed during the sump removal program.

A.3. Basis for Taking Action. Environmental restoration at CS-6/FS-22 followed the CERCLA SI process. Provided below is a summary of investigations performed at Study Area CS-6/FS-22.

<u>Preliminary Assessment</u>: Study Area CS-6/FS-22 was identified in the Task 6 Records Search as an area of potential contamination (E.C. Jordan Co. 1986).

<u>Site Inspection and Verification Sampling</u>: An SI (CDM 1996) was conducted at CS-6/ FS-22 in 1992 and 1993. The SI included surface soil, subsurface soil and groundwater sampling. Collected samples were analyzed for VOCs, SVOCs, inorganics, pesticides/PCBs, and TPH. Additional sampling was conducted in 1994. Field observations and analytical results identified and quantified minimal levels of compounds at CS-2/FS-22. Small quantities of petroleum hydrocarbons were discharged to the surface from the old OWS; however, verification sampling conducted in 1994 indicated little or no residual fuel contamination.

Data from the SI and the 1994 verification sampling event were used to perform a PRE for surface soil, subsurface soil, and groundwater. There were some exceedances of Tier I HECs for some constituents in the surface soil PRE; therefore a PRA for surface soil was completed for FS-22 and the southeast stained soil area of CS-6. For the surface soil PRA, the risk was calculated based on future residential use. Carcinogenic risks from surface soil (1.44×10^{-5}) were within EPA target risk range. The noncarcinogenic health index (HI) was less than 1. The maximum detected concentration of lead

(392 mg/kg) was below the range of calculated Preliminary Remedial goals. For subsurface soil, a Tier I PRE based on occupation (i.e., worker) use was performed. No Tier I HECs were exceeded. For groundwater, dieldrin, manganese, beryllium, and bis(2-ethylhexyl) phthalate (BEHP) exceeded Tier I HECs. However, only BEHP exceeded the MCL. No groundwater contaminants of concern were selected.

In 1999, groundwater was sampled from three monitoring wells at the request of the MassDEP. Samples contained elevated concentrations of bis-ethylhexyl phthalate and sodium. However because BEHP was recognized as a common laboratory contaminant and sodium is considered a nutrient, no additional action was required to address groundwater.

B. No Further Action Decision

This section presents a summary of the no further action decision for AOC CS-6/FS-22.

Decision Document: A Decision Document documenting the no further action decision was finalized in March 2000 (AFCEE 2000). The no further action was based on multi-media sampling conducted as part of the SI, 1994 verification sampling event, and 1999 verification sampling event. The no further action decision was also based on the risk analysis for soil and groundwater based on current and anticipated land and groundwater use scenarios.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Study Area CS-6/FS-22 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action functioning as intended by the decision documents?

Not applicable, no remedial/removal action was conducted at Study Area CS-6/FS-22.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action selection still valid?

Changes in Standards and To-Be Considered: Not applicable, no remedial/removal action was conducted at Study Area CS-6/FS-22.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action decision for Study Area CS-6/FS-22.

Changes in Toxicity and Other Contaminant Characteristics: There were no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the no further action decision.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action?

There is no other information at this time that calls into the question of the short-term protectiveness of the no further action decision based on current land use (i.e., DoD

and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are currently controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions

specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

AFCEE. 2000 (March). Final Decision Document Study Area Chemical Spill Site (CS-6)/Fuel Spill Site (FS-22). Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

CDM. 1996 (August). *Final Site Inspection Report Study Areas CS-1, CS-2, CS-6/ FS-22, FS-26, and FS-27*. Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1986 (December). U*.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory, Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

HAZWRAP. 1992 (October). *Sump Removal Action Program Phase I Sump Investigation Program Work Completion Report*. Prepared by ABB-ES, Portland, Maine, for HAZWRAP, Oak Ridge, Tennessee.

3.6.7 Chemical Spill No. 6 USCG (CS-6 USCG) Source

A. Background

A.1. Site Description. Study Area CS-6 USCG consists of the USCG Building 5215, which houses four maintenance shops: the electrical shop; utility shop; roads and grounds shop; and the "Do It Now" shop (Figure 1-1). The USCG has used Building 5215 since 1973. Before 1973, the ANG used the building as a Noncommissioned Officers club. Wastes generated at the shops included oils, hydraulic fluid, and cleaning solvents.

A.2. Previous Actions.

Underground Storage Tank and Aboveground Storage Tank Action: A 2,000-gallon UST (CPT-45) and two aboveground storage tanks (ASTs) (CPT-46 and CPT -47) were/are associated with this site. In September 1990, the Coast Guard enclosed the two ASTs in a "shed" complete with secondary containment. Contaminated soil adjacent to the ASTs was detected during this project. Approximately six cubic yards of soil from this area were consolidated with other contaminated soil from Fuel Spill Site 26 and manifested off-site to an asphalt batching facility (AMREC, Southborough, MA). In May 1993, CPT-45 and the 475,000-gallon AST (CPT-46) were removed in accordance to MassDEP regulations (AFCEE 2000). AST CPT-47 is still located at the site and is currently in service.

A.3. Basis for Taking Action. Environmental restoration at Study Area CS-6 USCG followed the CERCLA SI process. Provided below is a summary of investigations performed at Study Area CS-6 USCG.

Preliminary Assessment: The CS-6 USCG study area was identified in the *Phase I: Records Search, Task 7* (E.C. Jordan Co. 1986) as a potential site of past uncontrolled disposal of hazardous substances. According to the records search, the roads and grounds shop generated the largest quantity of wastes. Spills and disposal of unknown quantities

of these wastes onto the ground and into the street reportedly have occurred. Some of these spills may have traveled into the storm drain system, which ultimately discharged to Edmunds Pond, located approximately 1 mile southwest of the study area.

Site Inspection: An SI was completed for Study Area CS-2 USCG in 1993 as part of the Priority Two and Priority Three Study Areas Site Inspection (ABB-ES 1993). The SI included the collection of four surface soil samples, one subsurface soil sample, one sediment sample, and one groundwater sample. Surface soil samples were analyzed for all or several of the following: VOCs, SVOCs, pesticides, PCBs, TPH, and inorganics. The subsurface soil sample was analyzed for VOCs, SVOCs, and inorganics. The sediment sample was analyzed for VOCs, SVOCs, pesticides, PCBs, and TPH. The groundwater sample was analyzed for VOCs, SVOCs, and inorganics. In 1999, four subsurface soil samples were collected in the former area of the ASTs. These samples were analyzed for VOCs and EPH/VPH. Results were documented in the Decision Document (AFCEE 2000).

Surface soil analytical results from CS-6 USCG collected in 1989 indicate minor fuel spills in the area around the former locations of CPT-46 and CPT-47. The upper 1.5 to 2 feet of soils in this area were physically removed off-site in 1990, as part of the AST removal. As indicated by the lack of petroleum hydrocarbons detected in subsurface soil samples collected beneath this area in 1999, the extent of soil removal conducted in 1990 effectively removed fuel-impacted soil. The highest total concentration of PAHs (3.2 mg/kg) was observed from TP-4. It is likely that a portion of this total concentration was from non-point sources such as vehicle exhaust or deteriorating asphalt (AFCEE 2000).

Sediment analysis results from Edmunds Pond showed evidence of fuel and pesticides being transported to the pond through the drainage system. The likely sources of the SVOCs, and pesticides identified in this sample are from non-point sources (i.e., stormwater runoff). It is not possible, based on the large area that contributes runoff

to the discharge at Edmunds Pond, to imply that spills at Study Area CS-6 USCG are directly responsible for the analytes detected in pond sediments (AFCEE 2000).

Groundwater appears not to have been affected by site activities. Most of the contaminants detected in the study area samples are strongly adsorbed to the soil matrix and likely would not pose an immediate threat to groundwater (AFCEE 2000).

Data from the SI was used to perform a human health PRE for Study Area CS-6 USCG. For surface soil, a Tier I PRE based on a residential exposure scenario was performed. Tier I HECs were exceeded for arsenic and beryllium. However, concentrations of these constituents were indicative of typical background concentrations. Benzo (a) pyrene also exceeded its HEC but the concentration was below the MassDEP S-1/GW-1 standard. A Tier II PRE was performed for surface soil; however the concentrations were all below HECs. For subsurface soil, a Tier I PRE based on a worker exposure scenario was performed. No HECs were exceeded. Sediment from Edmunds Pond was also evaluated. No HECs were exceeded. For groundwater, maximum concentrations of analytes were compared to PRE Tier I HECs (residential exposure scenario) and to available MCLs. No HECs or MCLs were exceeded.

An ecological PRE was also performed for Study Area CS-6 USCG. Except for BEHP and zinc, which exceeded the screening values for the upland sandpiper in surface soils, no risks to ecological receptors were identified in the ecological PRE. The BEHP concentration of 37 mg/kg exceeded the HEC of 0.812 mg/kg. However, BEHP was detected in one of four samples, and is a common sampling and laboratory contaminant. Furthermore, BEHP is not typically associated with fuels. Based on this information, BEHP is not likely a site-related contaminant. The zinc concentration of 67 mg/kg exceeded the HEC of 3.98 mg/kg. Zinc was only detected in one of two samples analyzed and, although it exceeded the HEC, the average MMR background concentration for zinc exceeds the upland sandpiper HEC by four times. A significant portion of the risk associated with the zinc concentration can be linked to background

concentrations, not site activities. Soils from which the maximum zinc and BEHP concentration were detected have since been removed off-site. This action has likely reduced ecological risk.

The sediment data indicated that there is potential risk for ecological receptors in Edmunds Pond. However, due to the extensive storm-drain network associated with this discharge point, no direct correlation can be made to Study Area CS-6 USCG activities.

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area CS-6 USCG.

Decision Document: A Decision Document documenting the no further action decision was finalized in November 2000 (AFCEE 2000). The no further action was based on multi-media sampling conducted as part of the SI; the results of the human health risk analysis for soil and groundwater based on current and anticipated land and groundwater use scenarios; and results of the ecological risk analysis. Furthermore, several fuel storage structures and associated soils were removed.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Study Area CS-6 USCG was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action functioning as intended by the decision documents?

Not applicable, no remedial/removal action was conducted at Study Area CS-6 USCG. However, fuel storage structures and associated soils were removed.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action selection still valid?

Changes in Standards and To-Be Considered: Not applicable, no remedial/removal action was conducted at Study Area CS-6 USCG.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action decision for Study Area CS-6 USCG.

Changes in Toxicity and Other Contaminant Characteristics: There were no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the no further action decision.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional

cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1993 (October). Priority *2 and 3 Study Areas Site Investigation; IRP/MMR.* Prepared by ABB Environmental Services for Hazardous Waste Remedial Actions Program; Portland Maine.

AFCEE. 2000 (April). *Decision Document of U.S. Coast Guard Chemical Spill No. 6 [CS-6 USCG] Study Area.* Prepared by AFCEE/MMR Installation Restoration Program Otis ANG Base, MA.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.8 Chemical Spill No. 8 USCG (CS-8 USCG) Source

A. Background

A.1. Site Description. AOC CS-8 USCG, initially consisted of three areas, however only one area was identified for further action. This area known as the Abandoned Radio Cabinet Area is a relatively small (approximately 400 square feet) site located on the Coast Guard Transmitter Station property adjacent to the eastern boundary of the MMR (Figure 1-1).

A.2. Initial Response. None.

A.3. Basis for Taking Action. Environmental restoration at AOC CS-8 USCG followed the CERCLA non-time critical removal action process. Provided below is a summary of investigations performed at AOC CS-8CSCG.

Preliminary Assessment: A PA for the AOC CS-8 USCG was completed in 1999 (AFCEE 2000). The PA included a review of available information on file for the site at local and state agency offices, interviews with persons familiar with the site, and several site visits. Based on the findings of the PA, AFCEE recommended further investigations for AOC CS-8 USCG.

Site Investigation: The SI included the collection of two shallow soil samples (0-6 inches bgs and 18-24 inches bgs) from directly beneath the radio cabinet. The soil samples were analyzed for PCBs and metals. Based on elevated levels of PCBs, two additional soil samples were collected from immediately adjacent to the two initial locations and were analyzed for PCBs only.

A human health PRE based on residential exposure scenario was completed as part of the SI. An ecological PRE was completed to evaluate potential ecological risks associated with exposure to contaminated surface soil (0 to 2 ft bgs). The COCs identified at AOC

CS-8 USCG were cadmium, manganese, and aroclor 1254. All three chemicals were considered both human health and ecological COCs.

Engineering Evaluation/Cost Analysis: An EE/CA was completed for Study Area CS-8 USCG in May 2002 (AFCEE 2002a). Additional surface soil and subsurface soil samples were collected and analyzed for PCBs to better define the extent of contamination. The following four alternatives received detailed analysis in the EE/CA:

- Alternative 1: No Action
- Alternative 2: Engineering Controls
- Alternative 3: Disposal at a Chemical Landfill
- Alternative 4: Incineration

B. Removal Action

This section presents the regulatory actions, RAOs, a description of the selected removal action, and a summary of the removal action implementation at AOC CS-8 USCG.

B.1. Regulatory Actions.

Action Memorandum: The CS-8 USCG AM (AFCEE 2002b) was prepared to document the decision to perform a removal action at AOC CS-8 USCG. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 3 which included excavating soil contaminated with COCs (approximately 80 cubic yards) above RALs and transporting the contaminated soil to an appropriately licensed landfill for disposal.

B.2. Removal Action Objectives. The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. Table B-1 presents COCs and their respective cleanup levels. The following RAOs were established for AOC CS-8 USCG:

- Protect ecological and human receptors at AOC CS-8 USCG by mitigating direct exposure to soil contaminated with cadmium, manganese and Aroclor 1254 by excavating and disposing of all soil with COC concentrations greater than the RALs.

Table B-1
COCs and RALs for CS-8 USCG

COC	Basis	RAL (mg/kg)
Aroclor 1254	Human Health/Eco	1
Manganese	Human Health	274
Cadmium	Human Health	1.8

B.3. Removal Action Implementation. AFCEE completed the removal action in December 2002. Removal activities and results of confirmatory sampling are documented in an RAR (AFCEE 2003). Approximately 25 cubic yards of contaminated soil were excavated from beneath the former location of the abandoned radio cabinet. Excavated soil was transported and disposed of at CWM Chemical Services, a chemical landfill, in Model City, New York.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Removal action activities were completed and documented in the CS-8 USCG Abandoned Radio Cabinet Area Removal Action Report (AFCEE 2003).
- AOC CS-8 USCG was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The removal action has been completed and is functioning as intended by the AM.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: EPA Region IX revised PRGs in 2008. The residential screening level for cadmium increased from 37 mg/kg to 70 mg/kg in 2008. The PRG update does not affect the protectiveness of the removal action.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in toxicity or other contaminant characteristics.

Changes in Risk Assessment Methods: There were no changes in risk assessment methodology.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no information that calls into question of the protectiveness of the removal action.

E. Issues

None.

F. Recommendations and Follow-Up Actions

None.

G. Protectiveness Statement

The no further action decision for this site protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing concentrations of COCs above RALs have been removed. No land-use restrictions are required for the site and the site no longer requires a five-year review.

H. References

AFCEE. 2003 (August). *CS-8 USCG Abandoned Radio Cabinet Area Removal Action Report.* Prepared by Jacobs Engineering Group for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2002a (May). *Chemical Spill-8 Coast Guard Abandoned Radio Cabinet Area Engineering Evaluation/Cost Analysis (EE/CA).* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2002b (August). *Chemical Spill-8 Coast Guard Abandoned Radio Cabinet Area Action Memorandum.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2000 (March). *Final Preliminary Assessments for Chemical Spill-8 Coast Guard and Chemical Spill-22.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.9 Chemical Spill No. 10 (CS-10)/Fuel Spill No. 24 (FS-24) Source

A. Background

A.1. Site Description. AOC CS-10/FS-24 occupies approximately 38 acres at the eastern boundary of the MMR at the southeast corner of the Range Maneuver and Impact Area (Figure 1-1). Originally, the AOC CS-10/FS-24 consisted of a number of buildings constructed as part of the BOMARC site by the USAF. Shelters utilized by the missile launcher systems along with a subsurface utility corridor connecting the shelters (utilidor system) were removed from the site in 2005. The site is currently used by the Massachusetts ARNG as the Unit Training Equipment Site (UTES) facility for maintenance and storage of vehicles.

Before 1956, CS-10/FS-24 consisted of a wooded area. Construction of the BOMARC missile site began in 1958. Between 1960 and 1973, the USAF maintained approximately 56 BOMARC ground-to-air missile launcher systems in a state of operational readiness. Maintenance operations involved the use of cleaning solvents [methylene chloride, 1,1,1-trichloroethane (1,1,1-TCA), TCE, PCE, and Freon]. BOMARC fuels included JP-4, Aeorzine-50, red fuming nitric acid, and hydrazine. Fuels used for power and heat generation included No. 2 fuel oil and diesel fuel. Several buildings had floor drains connected to leaching wells, building sumps, oil interceptors, and other drainage structures; some of these drainage structures were connected to the site storm drain system, which discharges to either the Eastern Storm Sewer Drainage Impoundment or the Southern Storm Sewer Outfall Drainage Ditch. The facility was abandoned by the USAF in 1973.

In 1978, the ARNG incorporated the abandoned missile facility into Camp Edwards and began limited use of the abandoned buildings for equipment maintenance and storage. The UTES has been in operation at AOC CS-10 since 1978. UTES personnel are responsible for maintaining 300 to 350 armored track and wheeled vehicles used for

Camp Edwards ARNG training activities. Motor oil, hydraulic fluid, battery electrolyte, PCE, PD-680 Safety Clean, paints, and paint removers have been used on-site.

A.2. Initial Response. The following investigations and remedial actions were conducted at AOC CS-10/FS-24.

Underground Storage Tank Removal: A 25,000 gallon UST located at the northwest corner of Building 4606 was removed. Fewer than 500 gallons of No. 2 fuel oil were reportedly released during the removal process. This fuel spill was designated FS-24. Soil affected by the fuel spill were excavated to the maximum extent possible and removed from the site, and the excavation was backfilled with clean sand.

Drainage Structure Removal Program: Sixteen drainage structures, associated piping, and surrounding soil was removed and two drainage structures were cleaned and filled in place with concrete at AOC CS-10 as part of the In addition to the drainage structures, a total of 31,550 gallons of liquids were removed from the structures and 702 cubic yards of contaminated soil was removed.

A.3. Basis for Taking Action. Environmental restoration at AOC CS-10/FS-24 followed the CERCLA remedial action process. Provided below is a summary of investigations performed at AOC CS-10/FS-24.

Preliminary Assessment: As part of the PA conducted in 1986 for the IRP at the MMR, AOC CS-10/FS-24 was identified as a potential site of past uncontrolled disposal of hazardous substances (E.C. Jordan Co. 1986).

Site Investigation: An SI that included soil, sediment, and groundwater sampling was conducted. It was concluded that UTES and BOMARC maintenance and operational activities had resulted in site contamination and that the soil sources of groundwater contamination might still exist at the site (E.C. Jordan Co. 1989 and 1990).

Remedial Investigation: An interim RI and Final RI characterized potential sources of groundwater contamination, confirmed conceptual models, and delineated the extent of contaminant source areas (i.e., leaching pits, oil/water interceptors, residual soil). AOC CS-10/FS-24 was divided into nine details which are described below (CDM Federal Programs Corporation 1997).

- Detail A consisted of surface soil contamination associated with an abandoned electrical switching station located southeast of Building 4672. Surface soil samples collected in the vicinity of the abandoned electrical switching station along the utilidor system were found to contain elevated concentrations of TPH and metals.
- Detail B consisted of surface soil contamination associated with operations at a former BOMARC maintenance shop located northeast of Building 4641. PAH and TPH were detected in surface soils.
- Detail C consisted of subsurface soil contamination associated with a former 300-gallon JP-4 UST located on the north side of Building 4602. PCE and TPH were detected in subsurface soils. Leaching of contaminants to groundwater was a concern for this detail.
- Detail D consisted of surface soil contamination associated with waste oil disposal activities. The disposal site is located in a clearing in the woods approximately 150 feet north of the BOMARC security fence. Lead and TPH were detected at elevated concentrations in surface soil at this detail.
- Detail E consisted of surface soil and sediment contamination associated with the Southern Storm Sewer Outfall Drainage Ditch. One 24-inch-diameter storm sewer receives runoff from southern portions of AOC CS-10. In the past, effluent from the leaching wells at Building 4606 and effluent from the waste oil interceptor at Building 4601 also discharged at the Southern Storm Sewer Outfall. Surface soils contained pesticides, TPH, PAHs, and metals.
- Detail F consisted of surface soil and sediment contamination associated with the Eastern Storm Sewer Outfall Drainage Impoundment. The drainage impoundment is located northeast of Building 4600 just outside the BOMARC security fence. Four storm sewer outfalls discharge to this impoundment. One storm sewer receives runoff from the vicinity of the Building 4600 area. Another received runoff from the area around Buildings 4641 and 4642. In the past, effluent from the former Weapons Systems Electronics Shop's oil interceptor also drained through this storm sewer at Building 4642. In the past, discharge from the Building 4602 shop area floor trench drains also drained through this storm sewer. PAHs, PCBs, and several metals were detected at the Eastern Sewer Drainage Impoundment.

- Detail G, also known as FS-24, consisted of subsurface soil contamination associated with a former 25,000-gallon UST located off the northeast corner of Building 4606. Methylene chloride and TPH were detected in subsurface soils. Leaching of contaminants to groundwater was a concern for this detail.
- Detail H consisted of subsurface soil contamination associated with a former storage area that was located adjacent to, and immediately west of, former Building 4642. PCE and TPH were detected in subsurface soils. Leaching of contaminants to groundwater was a concern for this detail.
- Detail I consisted of surface and subsurface soil contamination associated with maintenance operations at Building 4601. Metals were detected in surface soil. PCE was detected in subsurface soils.

As part of the RI**,** a human-health PRA was performed to evaluate potential human-health risks associated with exposure to contaminated surface soil, sediments, and surface water under residential exposure scenario. Results of the human-health PRA indicated carcinogenic and noncarcinogenic risks associated with all areas and environmental media evaluated in the RI do not exceed EPA risk management guidelines. However, in some cases, the MassDEP carcinogenic risk management guideline of $1x10^{-5}$ was exceeded. The ecological PRA evaluated potential ecological risks associated with exposure to contaminated surface soil (0 to 2 ft bgs). Results of the PRA triggered the need for an evaluation of remedial alternatives.

<u>Remedial Alternatives</u>: The following alternatives were presented in the CS-10/FS-24 Feasibility Study and a comparative analysis of these alternatives was performed to assess how well the alternatives would meet the evaluation criteria while controlling migration of contaminants from deep soil to groundwater at the AOC (AFCEE 1998).

- Alternative 1: No action
- Alternative 2: Limited action
- Alternative 3: Excavation, On-site Asphalt Batching and Off-Site Disposal/In Situ Thermally Enhanced SVE/Environmental Monitoring
- Alternative 4: Excavation and Off-site Asphalt Batching/In Situ Thermally Enhanced SVE/Environmental Monitoring

- Alternative 5: Excavation and Off-site Landfill Disposal/In Situ Thermally Enhanced SVE/Environmental Monitoring

B. Remedial/Removal Actions

This section presents the regulatory actions, RAOs, a description of the selected remedy, and a summary of the remedy implementation at AOC CS-10/FS-24.

B.1. Regulatory Actions. Described below are the controlling documents that present the selected remedy and post-ROD documents that identified changes to the selected remedy.

Record of Decision: The selected remedy for AOC CS-10/FS-24 is Alternative 3: Excavation, On-site Asphalt Batching and Off-site Disposal/In Situ Thermally Enhanced SVE/Environmental Monitoring. This alternative included institutional and engineering controls to limit exposure to site-related contaminants and to reduce source area soil contaminant concentrations to protective levels. Nine discrete source areas (i.e., Details A through I) were identified in the CS-10/FS-24 Source Area ROD (AFCEE 1999). The major components of this alternative included: the removal of contaminated surface water from the Eastern Storm Sewer Outfall Drainage Impoundment at Detail F; excavation, dewatering (if necessary) and temporary on-site stockpiling of an estimated 3,400 cubic yards of contaminated surface soil and sediments from seven of the nine source areas (Details A through F and I); installation of an in situ thermally enhanced soil vapor extraction (SVE) and vapor collection system at Detail C; and implementation of a confirmatory sampling plan at Details G and H. All areas where contaminated soil and sediments are removed would be backfilled with clean fill.

Explanation of Significant Differences: The *Explanation of Significant Differences for Areas of Contamination CS-10 (A, B & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; SD-3/FTA-3/CY-4* finalized in January 2003 (AFCEE 2003) was prepared to document changes to the selected remedy for several sites in the SARAP including Details A, B, and E of the CS-10/FS-24 ROD. Three changes are made to the selected remedy

presented in the CS-10/FS-24 ROD: (1) establishment of RALs for certain inorganic chemicals, PCBs, and petroleum hydrocarbons at Details A, B, and E (Table B-1 and Table B-2); (2) removal of the asphalt-batching component from the selected remedy of Details A and B; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

Table B-1
Changes in Cleanup Levels at AOC CS-10/FS-24

Contaminant	Media/Basis	ROD RAL (mg/kg)	ESD RAL (mg/kg)
Aroclor	Soil/Human Health	15.8	1
Arsenic	Soil/Ecological	3.6	7.1
Cadmium	Soil/Ecological	1.5	1.8
Chromium	Soil/Ecological	6.8	19
Copper	Soil/Ecological	19.3	61
Lead	Soil/Ecological	15.8	99
Vanadium	Soil/Ecological	15.2	47
Zinc	Soil/Ecological	16	68
TPHs	Soil/Leaching	500	See Table B-2

Table B-2
MCP S-1/GW-1 Standards for Petroleum Hydrocarbons

Type of Petroleum Hydrocarbons	New RAL (mg/kg)
Aliphatic Hydrocarbons	
C_5 through C_8 Aliphatic Hydrocarbons	100
C_9 through C_{12} Aliphatic Hydrocarbons	1,000
C_9 through C_{18} Aliphatic Hydrocarbons	1,000
C_{19} through C_{36} Aliphatic Hydrocarbons	3,000
Aromatic Hydrocarbons	
C_9 through C_{10} Aromatic Hydrocarbons	100
C_{11} through C_{22} Aromatic Hydrocarbons	1,000

B.2. Remedial Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The COCs identified at AOC CS-10/FS-24 are provided in Table B-3 (AFCEE 1999). MMR-specific STCLs used for the DSRP were retained and used to develop cleanup levels for identified contaminants of concern. In 2000, AFCEE with concurrence from EPA and MassDEP revised ecological risk based STCLs for inorganic chemicals in a technical memorandum (AFCEE 2000).

In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the technical memorandum (AFCEE 2002a). The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Specifically, the RAOs established for AOC CS-10/FS-24 were:

- To minimize adverse impacts to ecological receptors from source area contaminated soil, sediment, and surface water estimated to exceed a hazard index of 1 or exceed STCLs based on ecological risk.
- To provide a source control alternative that minimized future migration of contaminants in soil/sediments to the underlying aquifer and to off-site locations as determined by exceedances of STCLs based on leaching.
- To the extent feasible, to reduce the concentration of the inorganic contaminants of concern in soil/sediments to achieve or approach STCLs based on background (AFCEE 1999).

Table B-3
AOC CS-10/FS-24 COCs For Nine Source Areas/Details

Source Area	COCs
A	TPH, Arsenic, Cadmium, Chromium, Copper, Lead, Vanadium, Zinc
B	2-methylnaphthalene, 4-nitrophenol, Phenanthrene, TPH
C	PCE, TPH

Table B-3
AOC CS-10/FS-24 COCs For Nine Source Areas/Details

Source Area	COCs
D	Methylene Chloride, TPH, Lead, Vanadium
E	Benzene, Phenanthrene, Fluoranthene, Pyrene, Benzo(b)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(g,h,i)perylene, Endosulfan II, Dieldrin, Aroclor-1260, Aroclor-1254, TPH, Arsenic, Chromium, Copper, Lead, Manganese, Vanadium, Zinc, Cyanide
F - Soil	Methylene Chloride, 2-methylnaphthalene, Phenanthrene, Carbazole, Fluoranthene, Pyrene, Benzo(a)ahthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(g,h,i)perylene, Benzo(g,h,i)perylene, Dieldrin, Arochlor-1254, TPH, Chromium, Copper, Lead, Manganese, Vanadium, Zinc
F - Sediment	Methylene Chloride, Dieldrin, Aroclor-1254, TPH, Aluminum, Cadmium, Chromium, Copper, Lead, manganese, Vanadium, Zinc
G	Methylene Chloride, TPH
H	PCE, TPH
I	PCE, BEHP, Arsenic, Chromium, Lead, Vanadium

B.3. Remedy Implementation.

<u>CS-10 Details A, B, D, E, G, H, and I (Excavation and Disposal)</u>: AFCEE conducted remedial action activities in 2001 at AOC CS-10/FS-24. Removal activities and results of confirmatory sampling were documented in a RAR (AFCEE 2003). Approximately 250 cubic yards of contaminated soil were removed from the CS-10 Details A, B, E and H. Confirmatory sampling results indicated that the contaminate concentrations in soil were below the RALs. Excavated soil was transported to a central bulking facility located on the MMR. Soil from AOC CS-10/FS-24 was combined with soil from other sites excavated under AFCEE's SARAP. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. Soil from CS-10/FS-24

was disposed of at the Taunton Landfill in Massachusetts. Disposal activities were performed in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MassDEP 1997). Analytical results from the delineation sampling at CS-10 Details D, G, and I indicated that all COC concentrations are below RALs and consequently no soil removal was needed. A vadose zone characterization report employing VLEACH, an EPA-approved leaching model, was completed to address residual PCE contamination in subsurface vadose zone soils at CS-10 Details H and I. The report concluded that the PCE contamination in vadose zone soils would not impact groundwater (AFCEE 2002b).

<u>CS-10 Detail C Soil Vapor Extraction System</u>: A pre-remedial action delineation program was performed to identify the boundaries of PCE and petroleum hydrocarbon contamination and to optimize placement of extraction wells. PCE delineation results were compared to the ROD cleanup level of 10 micrograms per kilogram (μg/kg). Sampling was conducted in November 2000, December 2000, and December 2001 to determine the lateral and vertical extent of the contamination. Fourteen locations were sampled prior to startup of the SVE system. The contaminant stratum was found to be located between 4 and 45 ft bgs within the vadose (unsaturated soil) zone.

The CS-10 Detail C SVE system operated from February 2002 through June 2005. The SVE system consisted of three extraction wells, eight monitoring/observation wells, and a vapor treatment system. The hot injection wells that were a component in the ROD were not installed. The vapor treatment system included two 300-lb granular activated carbon (GAC) vessels, a moisture tank, and a thermal oxidizer. The thermal oxidizer was shut down in October 2003. The three extraction wells were shut down in March 2003, January 2004 and June 2005 respectively. The system was decommissioned in June 2005. A vadose zone characterization report employing VLEACH, an EPA-approved leaching model, was completed to address residual PCE contamination in subsurface vadose zone soils at CS-10 Detail C. The report concluded that the PCE contamination in vadose zone soils would not impact groundwater (AFCEE 2005b).

CS-10 Detail F Revised Screening Level Ecological Risk Assessment: The results of this Screening Level Ecological Risk Assessment suggest that wetland receptors (e.g., plants and invertebrates), aquatic and benthic receptors (e.g., invertebrates) may potentially be at risk from exposure to several inorganic compounds in hydric soil/sediment and surface water in CS-10 Detail F (Eastern Storm Sewer Outfall Drainage Impoundment). However, it was determined that little to no significant potential risks to vertebrate wildlife was likely from exposure to contaminants of potential concern (COPCs) in hydric soil/sediment (AFCEE 2004a).

CS-10 Detail F Ecological Risk Assessment Addendum: The ERA Addendum was prepared to evaluate the potential ecological risks to lower trophic level receptors through the benchmark screening of additional surface water and hydric soil/sediment samples and the use of site-specific laboratory toxicity testing. The results of this ERA Addendum indicated that, although there were elevated levels of several inorganic and organic chemicals present in surface water, sediments and hydric soils in the wetland portion of CS-10 Detail F, these levels were not likely to have a significant negative impact on the wetland plant and invertebrate communities (AFCEE 2004b).

Project Note 337105: CS-10 Source Area Investigation Results: A source area groundwater and subsurface soil investigation was completed at the CS-10 source area in 2005. The primary objectives of this investigation were to determine:

- The extent of groundwater contamination in the source area;
- If contamination extended into the vadose zone and represented a continuing source for groundwater contamination; and
- If groundwater contamination detected in the source area represented a continuous plume from the source area to a downgradient CS-10 groundwater extraction well.

These objectives were addressed through sampling of 27 existing monitoring wells, the completion of four groundwater screening borings, and subsurface soil sampling. All groundwater and soil samples were analyzed for TCL VOCs. For additional information

on the groundwater sampling program and results refer to Section 4.4.3 CS-10 Groundwater. Very low concentrations of PCE were detected in subsurface soil (below the MassDEP S-3/GW-1 standard). PCE contamination in this area was found not to represent a continuing source for the CS-10 plume and concentrations area expected to continue to decrease below the MCL in the near future (AFCEE 2006).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- Interim Remedial Action Report CS-10 Detail C Site; June 2003.
- Remedial Action Report Area of Contamination CS-10/FS-24; September 2003.
- Revised Screening Level Ecological Risk Assessment Area of Concern CS-10 Detail F; March 2004.
- Ecological Risk Assessment – Addendum Area of Concern CS-10 Detail F; October 2004.
- Project Note No. CS10C-1; CS-10, Detail C, Source Area, Evaluation of EPH/VPH Residuals at CS-10 Detail C; April 2005 (AFCEE 2005).
- Chemical Spill No. 10 Detail C Vadose Zone Characterization Report; June 2005.
- Shut down of SVE at CS-10 Detail C; June 2005.
- Project Note 337105-SPEIM-CS10-PRJNOT-001: CS-10 Source Area Investigation Results; May 2006.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy/removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

For CS-10 Details A, B, C, D, G, H, and I; the remedial actions have been completed and is functioning as intended by the ROD as modified by the ESD. For CS-10 Detail C, the remedial action has been completed; however a RAR and ESD need to be prepared. For CS-10 Detail F, no action is required based on the ecological risk analysis. A RAR and ESD for CS-10 Detail F need to be prepared.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: MassDEP has re-evaluated S-1/GW-1 soil standards for EPH/VPH since the last five-year review. The new S-1/GW-1 soil standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. The new MassDEP S-1/GW-1 soil standards do not change the protectiveness of the implemented remedy.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: MassDEP has re-evaluated S-1/GW-1 standards for EPH/VPH since the last five-year review. The MassDEP S-1/GW-1 standards are based on unrestricted use and take into consideration dermal exposure, ingestion exposure, and impact to groundwater. The new MassDEP S-1/GW-1 soil standards do not change the protectiveness of the implemented remedy.

Changes in Risk Assessment Methods: An ERA was completed in 2004 for CS-10 Detail F. The risk analysis used updated State and EPA guidance which resulted in no further action required for CS-10 Detail F.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

None.

F. Recommendations and Follow-Up Actions

Prepare and issue a RAR and ESD for CS-10 Details C and F.

G. Protectiveness Statement

The selected remedy for AOC CS-10/FS-24 protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios.

H. References

AFCEE. 2006 (May). Project Note: *CS-10 Source Area Investigation Results.* Prepared by CH2M HILL for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2005a (April). Project Note: *CS-10 Detail C, Source Area, Evaluation of EPH/VPH Residuals at CS-10 Detail C Excavation Proposal.* Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2005b (June). *Chemical Spill No. 10 Detail C Vadose Zone Characterization Report*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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______. 2004b (October). *Ecological Risk Assessment-Addendum Area of Concern CS-10 Detail F*. Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2003 (February). *Explanation of Significant Differences Areas of Contamination CS-10 (A,B,&C); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; and SD-3/FTA-3/CY-4.* Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2002a (September). *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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______. 1998 (September). *Massachusetts Military Reservation Focused Feasibility Study AOC CS-10/FS-24 Source Operable Units*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

CDM Federal Programs Corporation. 1997 (December). *Final Remedial Investigation UTES/BOMAR, and BOMARC Area Fuel Spill (AOC CS-10 and AOC FS-24) Source Operable Unit: CS-10A and CS-10B*. Prepared by HAZWRAP. Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan, 1990 (March). *Task 2-3B Site Inspection, Field Investigation Work Conducted Spring-Summer 1988*; Installation Restoration Program; Massachusetts Military Reservation. Prepared by E.C. Jordan Co. Prepared for HAZWRAP; Portland, Maine.

______. 1989 (March). *Task 2-3A Site inspection, Field Investigation Work Conducted Fall 1987*; Installation Restoration Program; Massachusetts Military Reservation. Prepared by E.C. Jordan Co, Prepared for HAZWRAP; Portland, Maine.

______. 1986 (March). *U.S. Air Force Installation Restoration Program, Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation*. Prepared by E.C. Jordan Co. Prepared for HAZWRAP; Portland, Maine.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

MassDEP, 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection,

3.6.10 Chemical Spill No. 11 (CS-11) Source

A. BACKGROUND

A.1. Site Description. AOC CS-11 is approximately 0.5 acres and is located between South Outer Road and Asphalt Road on the MMR. CS-11 consists of Building 1116, which was used by the ANG and ARNG as a pesticide shop for storage and mixing of pesticides and herbicides (Figure 1-1).

A.2. Basis for Taking Action. Environmental restoration at CS-11 followed the CERCLA non-time critical removal action process. Provided below is a summary of investigations performed at AOC CS-11.

Preliminary Assessment: This study area was identified in the Task 6 Records Search as an area of potential contamination (E.C. Jordan Co. 1986). According to the records search, from 1970 to 1983, pesticides and herbicides were mixed on an asphalt pad located on the eastern side of Building 1116. Reportedly, pesticides spilled during mixing were washed off the edge of the pad onto the surrounding soil.

Site Investigation: An SI was completed in October 1993 intended to determine the nature and extent of contamination at CS-11 (ABB-ES 1993). The investigation phase included the completion of five test pits and one monitoring well (MW-1). Pesticides detected included 4,4’-DDT, dieldrin, heptachlor, and methoxychlor. No herbicides or organophosphorus pesticides were detected in surface soil. Several target analyte list (TAL) metals were also detected in surface soil.

Based on results of the chemical analysis, it appears that pesticide spills occurred on the ground around the asphalt pad on the eastern side of Building 1116. Detected concentrations of dieldrin at one test pit location were higher than those observed at other study areas where normal use of the pesticide occurred, indicative of a spill (ABB-ES 1993).

A PRE was conducted for surface soil including human health under a future residential exposure scenario and an ecological exposure scenario. No risk evaluation was performed for subsurface soil. Results of the ecological and human health risk evaluations triggered the need for an alternative evaluation. COCs identified at AOC CS-11 included cadmium, chromium, lead, zinc, cyanide, and dieldrin. The Priority 2 and 3 Study Areas SI Report recommended a non-time-critical removal action at CS-11.

Engineering Evaluation/Cost Analysis: AOC CS-11 was included as part of the Priority 2 and 3 Study Areas and DDOU EE/CA completed in October 1998 (AFCEE 1998).

Alternatives that received detailed analysis in the EE/CA were:

- Alternative 1: On-base Thermal Desorption and Off-base Treatment and Disposal.
- Alternative 2: On-base Asphalt Batching and Off-base Treatment and Disposal.
- Alternative 3: Off-base Treatment and/or Disposal of Soil for AOC CS-11.

B. Removal Actions

This section presents the regulatory actions, RAOs, a description of the selected removal action, and a summary of the removal action implementation at AOC CS-11.

B.1. Regulatory Actions. Described below are controlling documents that present the selected removal action and post-AM documents that identified changes to the selected removal action.

Action Memorandum: The Priority 2 and 3 Study Areas and DDOU Source Removal AM (AFCEE 1999) was prepared to document the decision to perform removal actions at certain Priority 2 and 3 Study Areas including CS-11. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 2 which included excavating AOC CS-11 soil and treating the excavated material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility.

Action Memorandum Addendum: An AM Addendum was prepared to document changes to the selected removal action for several sites in the SARAP including CS-11 (AFCEE 2003). Three changes were made to the selected removal action presented in the Priority 2 and 3 Study Areas EE/CA: (1) establishment of RALs for certain inorganic chemicals and PCBs; (2) removal of the asphalt-batching component from the selected removal action; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2. Removal Action Objectives. The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The remedial response objectives included the removal of surface soil around the wash pad to reduce the risk of human and ecological exposure to dieldrin and several inorganics.

MMR-STCLs used for the DSRP (HAZWRAP 1996) were retained and used to develop cleanup levels for identified COCs. In 2000, AFCEE with concurrence from EPA and MassDEP revised ecological risk-based STCLs for inorganic chemicals in a technical memorandum (AFCEE 2000). In addition, AFCEE used EPA screening level guidance for Superfund sites as the RAL for PCBs. In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the technical memorandum (AFCEE 2002).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs were documented in an AM Addendum prepared in 2003 (AFCEE 2003). Presented in Table B-1 are RALs that must be achieved to meet remedial response objectives for CS-11.

Table B-1 COCs and RALs for CS-11		
COC	**Basis**	**RAL (mg/kg)**
Cadmium	Ecological	1.8
Chromium	Background	19
Lead	Ecological	99
Cyanide	Background	1
Dieldrin	Ecological/Human	.035
Zinc	Ecological	68

B.3. Removal Action Description. Using the AM and AM Addendum as described in Section B.1 as the procedures for removal action implementation, the removal action consisted of excavating contaminated soil at AOC CS-11. Excavated soil would be transported to an on-base central bulking facility for waste characterization. Excavated soil that has contaminant concentrations in exceedance of TCLP allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA Subtitle C TSDF. Soil that has contaminant concentrations below TCLP allowable concentrations and therefore deemed nonhazardous (and that are determined to contain contaminant concentrations below MassDEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be transported offsite to a Subtitle D facility. Post excavation confirmatory sampling would be conducted to ensure that all soil with COC concentrations exceeding CS-11 soil cleanup levels was removed.

B.4 Removal Action Implementation. AFCEE conducted a removal action in 2001 and 2002 at AOC CS-11. Approximately 715 cubic yards of contaminated soil was excavated from AOC CS-11. Depth of excavation ranged from 2 to 12 ft bgs.

Contaminant concentrations in confirmation samples collected below 2 ft bgs were compared to ecological cleanup levels (i.e., RALs specified in the AM Addendum). All the excavated soil was considered a listed RCRA-hazardous (P037) waste and was disposed of at a RCRA Subtitle C incinerator and/or RCRA Subtitle C landfill.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Final Priority 2 and 3 Study Areas and DDOU Removal Action Report: Completed in April 2004.
- AOC CS-11 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the AM modified by the AM Addendum.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

<u>Changes in Standards and To-Be Considered</u>: There have been changes in chemical-specific ARARs. MassDEP has re-evaluated S-1/GW-1 standards since the last five-year review. The new S-1/GW-1 standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. The MassDEP S-1/GW-1 standard for dieldrin increased from 0.03 mg/kg to 0.05 mg/kg. Dieldrin concentrations in the removal action confirmation

samples were lower than the ecological risk-based RAL of 0.035 mg/kg. The new MassDEP S-1/GW-1 standards do not change the protectiveness of the implemented removal action.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics: Ecological risk-based RALs were calculated using toxicity information available in 2000 which are presented in a technical memorandum (AFCEE 2000). The CS-11 removal action completed in 2002 was based partly on these ecological risk-based RALs. No changes in toxicity and/or contaminant characteristics triggered the need to reevaluate ecological risk-based RALs.

Changes in Risk Assessment Methods: The removal action was completed in 2002. There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the implemented removal action.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USGS). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

(1) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

2) MassDEP S-1/GW-1 standard for dieldrin has changed. AFCEE shall determine if the new standard is applicable.

G. Protectiveness Statement

The removal action selected for the AOC CS-11 (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing COCs above RALs have been removed. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness. There has been a change in the MassDEP S-1/GW-1 standard for dieldrin; however, the removal action remains protective.

H. References

ABB-ES. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation*, Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2004 (November). *Final Removal Action Report Priority 2 and 3 Study Areas and Drum Disposal Operable Unit.* Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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_____. 1998 (October). *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis.* Prepared for AFCEE/MMR Installation Restoration Program, Massachusetts Military Reservation by HAZWRAP, Portland, Maine.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory, Oak Ridge, Tennessee.

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HAZWRAP. 1996 (January). *Soil Target Cleanup Levels, DSRP*. Installation Restoration Program, Massachusetts Military Reservation. Prepared for AFCEE/MMR.

3.6.11 Chemical Spill No. 14 (CS-14) Source

A. Background

A.1. Site Description. Study Area CS-14 consists of the subsurface structures between Building 156 and Hangar 158 which received liquid waste material from these buildings (Figure 1-1). Potential contaminant sources for the CS-14 Study Area consisted of:

- A leaching pit located outside the southwest corner of Building 156.
- A sand/gas trap associated with Building 156.
- An OWS associated with Hangar 158 and the Building 156 sand/gas trap.
- Historical waste disposal practices.

A.2. Previous Actions.

Drainage Removal Structure Program: In 1996, two test pit/trenches were excavated in the area of the leaching pit as part of the DSRP. Evidence of the presence of the leaching pit or associated contamination was not found and the area was backfilled and regarded in place. On-site personnel reported no indications of typical drainage structure construction, piping, cobblestone fill, staining, odors, or other contaminant indicators. The OWS was not removed because it was not a drainage structure. However, the sand originally used to backfill the structure was removed and the structure was steam-cleaned and filled in place with concrete during the DSRP in April 1996. The inlet and outlet for two manholes (i.e., 98CDXX7 and 98CDXX9) associated with the abandoned OWS were blocked with concrete as part of the DSRP.

A.3. Basis for Taking Action. Environmental restoration at Study Area CS-14 followed the CERCLA SI process. Provided below is a summary of investigations performed at Study Area CS-14.

Preliminary Assessment: The CS-14 study area was identified in the *Phase I: Records Search, Task 7* (E.C. Jordan Co. 1986) as a potential site of past uncontrolled disposal of

hazardous substances. Wastes reportedly discharged to these structures included chlorinated solvents and waste petroleum products.

Site Investigation: As a result of the 1986 records search, contamination at Study Area CS-14 was investigated and characterized during: a Phase I SI; a Phase II SI; a Sump Investigation Program; a Phase II Confirmation SI, monitoring of groundwater monitoring well MW-1; and additional groundwater sampling.

Phase I Site Investigation: Phase I of the CS-14 SI (ABB-ES 1993) was designed to investigate whether soil and/or groundwater at the CS-14 Study Area were significantly impacted by waste disposed of in the leaching pit. The Phase I field program consisted of a soil gas survey and installation and sampling of one groundwater monitoring well (MW-1) located downgradient from the study area. Groundwater was analyzed for TCL VOCs, SVOCs, and inorganics. PCE was detected in groundwater.

Phase II Site Investigation: Phase II of the SI (ABB-ES 1993) was designed to further investigate the contamination detected from the soil gas survey and to evaluate the potential that groundwater directly below the leaching pit had been impacted. Two additional wells were installed. Six soil samples were collected during the advancement of soil boring next to the leaching pit. Three subsurface soil samples were submitted for off-site laboratory analysis of TCL VOCs. Groundwater samples were collected from MW-1, MW-2, and MW-3 and analyzed off-site for TCL VOCs, SVOCs, and inorganics. Low levels of chlorinated VOCs were detected in groundwater samples. Methylene chloride was detected at a low concentration in subsurface soil.

Sump Removal Action Program/Phase I Sump Investigation Program: From November, 1991 to February 1992, an extensive subsurface soil and liquid/sediment sampling program was conducted at Study Area CS-14 in order to further characterize the nature and extent of contamination associated with the subsurface structures between Hangar 158 and Building 156. The results were used for the final disposition of these

subsurface structures under the DSRP. One liquid and sediment sample from the sand and gasoline trap and sediment and/or liquid samples from various manholes associated with the abandoned OWS were analyzed for selected VOCs, SVOCs, pesticides, inorganics, and TPH. Subsurface soil sampling at the sand and gasoline, leaching pit and abandoned OWS was also conducted. Samples were analyzed for selected VOCs, SVOCs, pesticides, inorganics, and TPH. VOC, SVOC, TPH, pesticide, and inorganic analytes were detected in samples collected within the soil/gas trap.

VOC contaminants and zinc were detected in the sand sample collected within the old OWS. VOC and inorganic analytes were detected in samples collected from the manholes previously associated with the old OWS. Field analytical results for subsurface soil samples showed VOC, SVOC, and inorganic compounds at concentrations less than the Tier 1 or Tier 2 human health and ecological risk/HECs as outlined in the MMR RAH.

Confirmation Study/Southeast Region Groundwater Operable Unit: Study Area CS-14, groundwater was grouped into one operable unit – the Southeast Groundwater Operable Unit (SERGOU). In 1993, as part of the SERGOU investigation, two additional monitoring wells were installed downgradient of Study Area CS-14. Monitoring wells MW-1 through MW-5 were sampled and analyzed for VOCs, SVOCs, inorganics, and TPH. In the groundwater sampling rounds conducted from 1990 to 1993, several VOCs were detected from monitoring wells MW-1, MW-2, MW-3, and MW-4; however none exceeded MCLs. TPH and SVOCs were not detected in groundwater samples collected from the five wells (MW-1 through MW-5).

Eastern Briarwood Groundwater Monitoring Program: Due to the presence of chlorinated solvents detected in groundwater within the SERGOU, certain wells within the SERGOU were selected to monitor the chlorinated solvent concentrations. Monitoring Well MW-1 at Study Area CS-14 was sampled for VOCs on a quarterly basis. PCE was detected above the MCL of 5 μg/L. during two sampling rounds;

however, the average PCE groundwater concentration detected in MW-1 over seven rounds was below the MCL.

Confirmational Sampling Rounds: The objective of the February/March 1999 confirmational sampling round was to determine the presence or absence of groundwater contamination at certain wells. Three wells (MW-1 through MW-3) were redeveloped to remove as much particulate matter as possible and sampled using the "Low Stress Low Flow; Purging and Sampling" technique to minimize the influence of colloids to verify or deny the presence of metals. In groundwater samples collected during the February/March 1999 round, only thallium was detected above risk/HECs in one well. A subsequent sampling event of this well and adjacent wells in October 1999 indicated thallium concentrations in groundwater were below laboratory detection limits.

Data from the SI and supplemental investigations was used to perform a human health PRE for Study Area CS-14. Surface soil was not evaluated. For subsurface soil, a PRE based on a utility worker exposure scenario was performed. No Tier I HEC was exceeded. For groundwater, a residential exposure scenario was evaluated. Maximum concentrations of contaminants of potential concern were compared to PRE Tier I HECs and available MCLs. Thallium and PCE exceeded MCLs. However, PCE was detected only twice in 14 rounds. Wells were sampled for thallium for several rounds. Thallium was not detected in latter rounds. Furthermore the calculated Hazard Index value did not exceed the threshold of 1.0 using the average exposure point concentration for thallium.

The SI indicated that it is unlikely that significant use of CS-14 by ecological receptors would occur since the potential release mechanisms for the site were located in the subsurface.

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area CS-14.

Decision Document: A Decision Document documenting the no further action decision was finalized in April 2000 (AFCEE 2000). The no further action was based on multi-media sampling conducted as part of the SI; the results of the human health risk analysis for soil and groundwater based on current and anticipated land and groundwater use scenarios. Furthermore, several drainage structures and associated soils were removed.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Study Area CS-14 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action functioning as intended by the decision documents?

Not applicable, no remedial/removal action was conducted at Study Area CS-14. However, structures and associated soils were removed as part of the DSRP.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action selection still valid?

Changes in Standards and To-Be Considered: Not applicable, no remedial/removal action was conducted at Study Area CS-14.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action decision for Study Area CS-14.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies that have triggered the need to evaluate the validity of the no further action decision.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation.* IRP/MMR. Prepared by ABB Environmental Services for Hazardous Waste Remedial Actions Program. Portland Maine.

AFCEE. 2000 (April). *Decision Document Study Area CS-14*. Prepared by Harding ESE Inc. for the AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1986 (December). U*.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.12 Chemical Spill No. 15 (CS-15) Source

A. Background

A.1. Site Description. Study Area CS-15, located on the southeast side of MMR, on Reilly Road, was used for jet engine testing from 1949 until 1985 (Figure 1-1). This study area consisted of Building 202, Building 204, and the area surrounding these buildings. In 1994, both buildings, the asphalt pavement, and three hanging transformers were removed. The site was regraded and seeded with grass. In 1996, former Building 204 gasoline trap was removed under the DSRP. Potential contaminant sources for Study Area CS-15 consisted of:

- Oils, solvents, and fuels associated with the former jet engine testing buildings.
- Three hanging electrical transformers located west of Building 204.
- A former gas trap associated with Building 204.

A.2. Previous Actions

Drainage Removal Structure Program: The gas trap, located east of the former Building 204, was removed in April 1996 as part of the DSRP. Removal of the gas trap and approximately 74 cubic yards of soil were excavated and treated at the on-site asphalt batching facility. Subsurface soil samples were collected from the sides and bottom of the excavation to confirm that concentrations of contaminants were below the DSRP STCLs. The analytical data for the confirmation samples indicated that the detected concentrations for all samples were below the STCL values. Therefore, clean closure was confirmed for the gas trap.

Transformer Removal: A secondary source of potential contamination not identified in the records search at the study area was three hanging transformers west of Building 204. These transformers were removed in 1994 when Buildings 202 and 204 were demolished.

A.3. Basis for Taking Action. Environmental restoration at Study Area CS-15 followed the CERCLA SI process. Provided below is a summary of investigations performed at Study Area CS-15.

Preliminary Assessment: The CS-15 study area was identified in the *Phase I: Records Search, Task 7* (E.C. Jordan Co. 1986) as a potential site of past uncontrolled disposal of hazardous substances. Wastes generated at this time were washed to a floor drain that led to a gasoline trap outside the eastern side of the former Building 204. After passing through the gas trap, floor washings passed through an underground pipe to an open ditch southeast of the study area.

Site Investigation**:** Study Area CS-15 included a three-phase sampling effort for the SI (AB-ES 1993); a follow-on supplemental sampling effort conducted in 1995 (ABB-ES 1995), and a groundwater sampling effort conducted in 2000.

Site Investigation and Supplemental Soil Sampling: The soil investigation at Study Area CS-15 included the collection of surface soil and subsurface soil samples. Samples were analyzed for VOCs, SVOCs, inorganics, PCBs/Pesticides, and TPH. Additional soil samples were collected in 1995. The 1995 investigation focused on identifying VOCs in deep subsurface soils. Petroleum hydrocarbons and SVOCs were detected in moderate concentrations in surface soil. Low concentrations of pesticides were also detected in surface soil. In subsurface soil, samples contained low levels of PAHs and inorganics. No fuel-related VOCs were detected in subsurface soil.

Supplemental Groundwater Investigations: Groundwater samples were collected as part of the SI; however, because the inorganic data was suspect, additional groundwater samples were collected in 1995 and 2000. Low levels of VOCs and metals were detected.

Data from the SI and supplemental investigations was used to perform a human health PRE for Study Area CS-15. For soil, a PRE based on a utility worker exposure scenario

was performed. The calculated risk was within the EPA cancer risk range of $1x10^{-6}$ to $1x10^{-4}$. The calculated HI value for potential exposure to soil for the utility worker did not exceed the threshold of 1.0. For groundwater, a residential exposure scenario was evaluated. The calculated risk was within the EPA cancer risk range of $1x10^{-6}$ to $1x10^{-4}$. The calculated Hazard Index value did not exceed the threshold of 1.0.

An ecological PRE was also performed for Study Area CS-15. The ecological PRE showed that maximum concentrations of several inorganics exceeded the benchmarks for phytotoxicity and invertebrates. However, adverse effects to the community structure of both plants and invertebrates were unlikely due to the concentration of inorganics being within the background range for urban soil for Massachusetts and the spatial distribution of the contamination. The food source of herbivores and omnivores is not likely to be effected due to the abundant foraging areas nearby.

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area CS-15.

<u>Decision Document</u>: A Decision Document documenting the no further action decision was finalized in July 2001 (AFCEE 2001). The no further action was based on multi-media sampling conducted as part of the SI; the results of the human health risk analysis for soil and groundwater based on current and anticipated land and groundwater use scenarios; and results of the ecological risk analysis. Furthermore, several drainage structures and associated soils were removed.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Study Area CS-15 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action functioning as intended by the decision documents?

Not applicable, no remedial/removal action was conducted at Study Area CS-15. However, structures and associated soils were removed as part of the DSRP.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action selection still valid?

Changes in Standards and To-Be Considered: Not applicable, no remedial/removal action was conducted at Study Area CS-15.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action decision for Study Area CS-15.

Changes in Toxicity and Other Contaminant Characteristics: There are no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the no further action decision.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1995 (September) .*Supplemental Sampling Report Priority 2 and 3 Study Areas*. Massachusetts Military Reservation. Prepared for HAZWRAP, Portland, Maine.

_____. 1993 (October). Priority *2 and 3 Study Areas Site Investigation.* IRP/MMR. Prepared by ABB Environmental Services for Hazardous Waste Remedial Actions Program, Portland Maine.

AFCEE. 2001 (July). *Decision Document of Study Area CS-15.* Prepared by Harding ESE Inc. for the AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory. Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.13 Chemical Spill No. 16 (CS-16)/Chemical Spill No. 17 (CS-17) Source

A. Background

A.1. Site Description. AOC CS-16/CS-17 occupies approximately 80 acres along the southern MMR boundary near the Falmouth gate entrance to the MMR (Figure 1-1).

AOC CS-16/CS-17 is bounded to the north by Kittridge Road and an abandoned utility pole, on the east by Sandwich Road, and on the south and west by the MMR boundary. AOC CS-16/CS-17 consists of infiltration sand filter and sludge drying beds located adjacent to the former MMR sewage treatment plant (STP). In the past, waste battery electrolyte, cleaners, solvents, and paint thinners from various operations at MMR are believed to have been discharged to the sanitary sewer system. The former STP was decommissioned in 1997. As a result, none of the sand filter beds or sludge drying beds at AOC CS-16/CS-17 is currently in use. The former STP was replaced with the current upgraded STP, and discharge effluent is piped off-site to new sand filter beds located near the Cape Cod Canal.

A.2. Initial Response. The MMR STP Upgrade Program upgraded the former STP to discharge effluent to new sand filter beds near the Cape Cod Canal. During the upgrade program, all above ground structures were removed to approximately three feet below grade. The demolition of the STP structures was completed in 1997. There was minimal disturbance to the sand filter beds, sludge drying beds and bed liners during demolition activities.

A.3. Basis for Taking Action. Environmental restoration at AOC CS-16/CS-17 followed the CERCLA remedial action process. Provided below is a summary of investigations performed at AOC CS-16/CS-17.

Site Investigation: In 1990, SI activities included the completion of eleven soil borings with selected monitoring wells and the collection of 31 soil samples. Results indicated that surface soil from the inactive sand filter beds contained concentrations of pesticides,

PCBs and SVOCs (E.C. Jordan Co. 1990a). Additional SI sampling conducted in 1990 addressed data gaps from previous investigations. Activities consisted of the collection of two soil samples from beneath sludge piles. Results indicated that elevated concentrations of SVOCs and lead were present in the sludge piles, and elevated concentrations of metals in shallow soil samples from beneath the sludge piles (E.C Jordan 1990b).

Remedial Investigation**:** An RI was conducted in 1996 (ABB-ES 1996). AOC CS-16/CS-17 was divided into seven areas: (1) active sand filter beds, (2) inactive sand filter beds, (3) abandoned sand filter beds, (4) active sludge drying beds, (5) inactive sludge drying beds, (6) abandoned sludge drying beds, and (7) the former sewage sludge disposal area. Three areas contained contaminants at elevated levels. These areas are discussed below:

Active Sludge Drying Beds: Sludge at the active sludge drying beds was contaminated with pesticides, PCBs, and metals. Physical examination of the soil in these sludge beds identified less than six inches of sludge in these beds.

Inactive Sludge Drying Beds: Laboratory analytical data indicated that the inactive sludge drying beds were contaminated with dieldrin, PCBs, and metals. These analytes were not uniformly distributed among the beds.

Former Sewage Disposal Area: Sludge samples contained barium, chromium, copper, iron, lead, mercury, selenium, silver, zinc, and cyanide at concentrations exceeding MMR background concentrations for surface soil. Soil samples collected beneath the piles contained concentrations of chromium, copper, lead, mercury, and zinc at concentrations exceeding MMR background concentrations for surface soil. Detectable concentrations of pesticides were also present in the samples.

As part of the RI, a human health PRA was conducted for AOC CS-16/CS-17 surface soils. Exposure scenarios evaluated included current and future child trespasser scenarios

and potential future resident scenarios. Exposure pathways evaluated for each of these scenarios included dermal contact, ingestion, and inhalation of contaminants.

PRA calculations indicate estimated potential risks for all exposure scenarios using maximum and exposure point mean concentrations did not exceed EPA risk management criteria ($1x10^{-4}$ to $1x10^{-6}$).

Risk estimates for current and future trespasser scenarios were below the MassDEP risk management criteria of $1x10^{-5}$. However, the calculated risks for potential future residential exposure for exposure point mean concentrations and maximum concentrations were above or at the MassDEP risk management criteria. The calculated risk using exposure point mean concentrations was $1x10^{-5}$. The calculated risk using maximum concentrations was $4x10^{-5}$. The primary contributor to calculated cancer risk based on maximum concentrations was benzo(a)pyrene. Benzo(a)pyrene was not retained for remedial alternatives evaluation because the calculated risk based on maximum concentration was slightly above the MassDEP risk management guideline and the calculated risk based on the exposure point mean concentration was below the MassDEP risk management guideline.

High concentrations of lead were detected at AOC CS-16/CS-17. The IEUBK model was not used to determine potential adverse effects based on child exposure scenarios at AOC CS-16/CS-17. However, a cleanup level was developed for lead based on human-health risk because the maximum concentration (856 mg/kg) exceeds the MassDEP S-1/GW-1 standard of 300 mg/kg.

An ecological PRA was also completed to evaluate potential ecological risks associated with exposure to contaminated surface soil (0 to 2 ft bgs). The ecological risk-based COCs identified at AOC CS-16/CS-17 were Aroclor 1254, dieldrin, arsenic, chromium, copper, lead, and zinc.

Feasibility Study: A feasibility study was completed in September 1998 (AFCEE 1998b). Alternatives that received detailed analysis in the feasibility study were:

- No Action
- Permeable Cover
- Impermeable Cap
- Excavation, Asphalt Batching/On-site Treatment, and Off-site Disposal
- Excavation and Off-site Disposal

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and a summary of the remedy implementation at AOC CS-16/CS-17.

B.1. Regulatory Actions. Described below are controlling documents that present the selected remedy and post-ROD documents that identified changes to the selected remedy.

Record of Decision: The ROD was finalized in May 1999 and documented the selected remedy (AFCEE 1999). The selected remedy (Alternative Four in the feasibility study) consisted of excavation of contaminated surface soil at three source areas (i.e., “active” sludge drying beds, inactive sludge drying beds, and former sewage sludge disposal area); on-site cold-mix asphalt batching of recyclable excavated soil; off-site disposal of non-recyclable excavated soil at a RCRA Subtitle C facility; and post excavation confirmatory sampling to ensure that all soil with COC concentrations exceeding AOC CS-16/CS-17 soil cleanup levels were removed. The selected remedy was the same as the proposed remedy because there were no changes resulting from the public comments received as part of the Proposed Plan process. However, at the request of MassDEP, confirmation samples for mercury, which was not selected as a COC, would be collected after remedial action at the former sewage sludge disposal area.

Explanation of Significant Differences: An ESD was prepared to document changes to the selected remedy for several sites in the SARAP including CS-16/CS-17 (AFCEE 2003b). Three changes are made to the selected remedy presented in CS-16/CS-17 ROD: (1) establishment of RALs for certain inorganic chemicals and PCBs; (2) removal of the asphalt-batching component from the selected remedy; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2. Remedial Action Objectives. The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The remedial response objectives include: (1) reduce exposure to ecological receptors from metals at the active sludge drying beds, inactive sludge drying beds, and the former sewage disposal area and (2) reduce exposure of ecological receptors to PCBs and dieldrin at the active sludge drying beds and inactive sludge drying beds.

MMR-specific STCLs used for the DSRP (AFCEE 1996) were retained and used to develop cleanup levels for identified COCs. In 2000, AFCEE with concurrence from EPA and MassDEP revised ecological risk-based STCLs for inorganic chemicals in a technical memorandum (AFCEE 2000). In addition, AFCEE used EPA screening level guidance for Superfund sites as the RAL for PCBs (AFCEE 2003b).

In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the technical memorandum (AFCEE 2002).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs were documented in an ESD prepared in 2003 (AFCEE 2003b). Presented in Table B-1 are RALs that must be achieved to meet remedial response objectives for AOC CS-16/CS-17.

Table B-1
COCs and RALs for CS-16/CS-17

COC	Basis	RAL (mg/kg)
Aroclor 1254	Ecological	1
Dieldrin	Ecological	.035
Arsenic	Ecological	7.10
Chromium	Ecological	19
Copper	Ecological	61
Lead*	Ecological/Human	99
Zinc	Ecological	68

* Lead was determined to be both a human health and ecological COC. The more stringent (ecological risk-based) cleanup level was chosen as the RAL.

B.3. Remedy Implementation. AFCEE completed the remedial action in 2001 at AOC CS-16/CS-17. Remedial activities and results of confirmatory sampling were documented in a Remedial/Removal Action Report (RAR) which was completed in April 2003 (AFCEE 2003a). Soil with concentrations of mercury below 10 mg/kg (approximately 3,195 cubic yards) was combined with soil from other similar disposal requirements. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. AOC CS-16/CS-17 soil was disposed of at the Taunton Landfill, in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MassDEP 1994).

Soil with concentrations of mercury above 10 mg/kg (approximately 837 cubic yards) was stockpiled separately from the remaining excavated soil. Waste characterization indicated that this soil exceeded the MassDEP Landfill Reuse Levels making them ineligible for disposal in the State of Massachusetts. This soil was transported to the Turnkey Landfill in Rochester, New Hampshire, for disposal. The Turnkey Landfill is a permitted RCRA Subtitle D landfill.

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- Final Remedial Action Report for AOC CS-16/CS-17: Completed in January 2003 (AFCEE 2003a).
- AOC CS-16/CS-17 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the final site inspection indicate that the remedy has been completed as intended by the ROD modified by the ESD.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

<u>Changes in Standards and To Be Considered</u>: All the cleanup standards used for the remedial action at AOC CS-16/CS-17 were ecological risk-based. Lead was considered a human-health COC; however, the ecological risk-based cleanup standard which is more stringent was used as the RAL. No cleanup standards have been promulgated based on ecological risk.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: Ecological risk-based RALs for several inorganic constituents were calculated using toxicity information available in 2000 which are presented in a technical memorandum (AFCEE 2000). The CS-16/CS-17 remedial action completed in 2001 was based on these ecological risk-based RALs. No changes in toxicity and/or contaminant characteristics triggered the need to reevaluate ecological risk-based RALs.

Changes in Risk Assessment Methods: There were no changes in HHRA methodology.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The remedial action selected for AOC CS-16/CS-17 (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing COCs above ecological risk-based RALs have been removed. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1996 (January). *Final Remedial Investigation Report, Sewage Treatment Plant/Former Sewage Sludge Disposal Area, Area of Contamination CS-16/CS-17.* Installation Restoration Program, Massachusetts Military Reservation, Otis ANG Base, MA.

AFCEE. 2003a (April). *Final Remedial Action Report Area of Contamination CS-16/CS-17.* Prepared by Environmental Chemical Corporation for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2003b (January). *Explanation of Significant Differences Areas of Contamination CS-10 (A, B & C); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; and SD-3/FTA-3/CY-4.* Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2002 (September). *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2000 (December). *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1999 (May). *Record of Decision Area of Contamination CS-16/CS-17*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1998b (September). *Final Feasibility Study Area of Contamination: CS-16/CS-17*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 1996 (January). *Soil Target Cleanup Levels, DSRP*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1990a (December). *Site Inspection Report Addendum- Field Investigation Work Conducted Fall 1987*. Installation Restoration Program, Massachusetts Military Reservation, Otis ANG Base, MA.

_____. 1990b (March). *Site Inspection Report Addendum- Results of Additional SI Sampling Conducted Summer 1989, Task 2-3C*. Installation Restoration Program, Massachusetts Military Reservation, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

MassDEP. 1994. Interim Remediation Waste Policy for Petroleum Contaminated Soils, MADEP Bureau of Waste Site Cleanup, WSC-94-400.

3.6.14 Chemical Spill No. 18 (CS-18) Source

A. Background

A.1. Site Description. The CS-18 site is an area of about 1.5 acres and consists of a single artillery firing point, designated as Gun Position-9 (GP-9) which is located north of the cantonment area, west of the CS-10 source area (Figure 1-1). GP-9 was used for artillery training from the WWII era until 1997. In July 2001, the CS-18 site was used for artillery setup and mock firing exercises. GP-9 is one of several artillery firing points located north south and west of the Camp Edwards Impact Area.

During previous studies of the GPs, GP-9 was chosen as representative of the worst-case conditions for live ammunition firing and propellant burning of all the firing points. The GP-9 was selected because it was one of the most used GPs (apparently due to its proximity to the cantonment area of the base) and had the greatest mass of propellant burning during the 15-month period preceding the initial 1987 investigation (USAEHA 1987). CS-18 was initially designated as a CERCLA site based on the use of the area for burning excess artillery propellant on the ground, an activity that was discontinued in the early 1990s. The remaining GPs will be evaluated under the Camp Edwards Impact Area Groundwater Study Program.

A.2. Initial Responses. Not applicable.

A.3. Basis for Taking Action. Two investigations of the soil and/or groundwater contamination at CS-18 have been conducted previously. The first was conducted by the U.S. Army Environmental Hygiene Agency (USAEHA) in 1987, and the second by the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) in 1994.

1987 Soil Contamination Study**:** The purpose of this study was to determine whether the ash remaining from burning bags of propellant at Camp Edwards was a hazardous waste

and to determine the extent of environmental contamination in the soil from past propellant burning operations. The conclusion was that due to the high annual precipitation and the sandy nature of the soil at MMR, there is the potential to contaminate the groundwater beneath these sites. The recommendations were to install groundwater-monitoring wells to determine whether contamination had reached the water table and to discontinue burning propellants on the ground surface (USAEHA 1987).

<u>1994 USACHPPM Site Inspection</u>: USACHPPM completed a SI at GP-9 in October 1994. The SI included a preliminary human health and ecological risk evaluation. Field activities for the SI included soil sampling at a total of 18 locations, collected from three depths: surface (0-1 foot bgs) and subsurface (2 to 4 and 5 to 7 ft bgs). A total of 54 soil samples and 14 background samples were collected and analyzed for total metals, explosives compounds, and SVOCs. Four groundwater-monitoring wells were install and groundwater samples were analyzed for explosives compounds, metals, VOCs, SVOCs, pesticides and PCBs, herbicides, and EDB. The groundwater sample results did not indicate any significant contamination (USACHPPM 1994).

<u>Supplemental Site Investigation</u>**:** AFCEE completed an SSI for CS-18 in September 2002. The CS-18 SSI sampling effort included the following:

- Sampling of surface soil (0 to 0.5 ft bgs) and shallow subsurface soil (1.5 to 2 ft bgs) at 12 locations within the site;
- Sampling of subsurface soil (2, 4, 6, and 8 ft bgs) at three locations in the vicinity of the most elevated surface soil contamination;
- Installation, development, and sampling of three groundwater monitoring wells at two downgradient locations in the vicinity of the site;
- Sampling of the four existing groundwater monitoring wells at the site; and
- Analysis of all the soil and groundwater samples for a suite of organic compounds and inorganic elements that have a reasonable probability of being present at the site given the historical activities.

The analytical data was collected, and the nature and extent of the contaminants of potential concern were developed. The analytical data were used to conduct a human

health and ecological screening-level risk assessment to determine the overall impact of the contaminants on potential receptors at the site (AFCEE 2002).

AFCEE is currently proceeding with a removal action based on soil data collected during the SSI.

B. Remedial/Removal Actions

This section presents the regulatory actions, RAOs, and remedy description for the CS-18 study area.

B.1. Regulatory Actions. AFCEE has notified the agencies that a removal action to address soils contaminated with 2,4-DNT will be conducted. The requirement to develop an EE/CA is being evaluated.

B.2. Removal Action Objectives. While no formal RAOs have been developed, the concept of the proposed remedy is to remove a future potential source of groundwater contamination at CS-18.

B.3. Remedy Description. While no formal work plan has been developed, the conceptual approach for CS-18 will be a traditional soil excavation, transport and disposal, followed by confirmation sampling.

B.4. Remedy Implementation. Scheduled for 2009.

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review.

- Human Health Risk Assessment, Open Burning of Propellant Bags: Completed in January 1999 (USAEHA 1999)
- CS-18 Supplemental Site Investigation: Completed in September 2002 (AFCEE 2002)
- Groundwater Sampling in 2003 and 2006.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

This question is not applicable since no remedy has been implemented at CS-18.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: This question is not applicable since no remedy has been selected and CS-18 source area is presently in the CERCLA investigation process.

Changes in Exposure Pathways: This question is not applicable since no remedy has been selected and CS-18 source area is presently in the CERCLA investigation process.

Changes in Toxicity and Other Contaminant Characteristics: This question is not applicable since no remedy has been selected and CS-18 source area is presently in the CERCLA investigation process.

Changes in Risk Assessment Methods: This question is not applicable since no remedy has been selected and CS-18 source area is presently in the CERCLA investigation process.

Review of RAOs: This question is not applicable since no remedy has been selected and CS-18 source area is presently in the CERCLA investigation process.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

This question is not applicable since no remedy has been selected and CS-18 source area is presently in the CERCLA investigation process.

E. Issues

A final decision regarding CS-18 needs to be made and implemented.

F. Recommendations and Follow-Up Actions

Coordinate with regulatory agencies to determine a path forward for this site under CERCLA and the Safe Drinking Water Act.

G. Protectiveness Statement

A protectiveness determination for the CS-18 study area cannot be made at this time until further information is obtained.

H. References

AFCEE. 2002 (September). *Final Chemical Spill-18 Supplemental Site Investigation Technical Memorandum.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

USACHPPM. 1994 (October). *Draft Final Site Inspection, Geohydrologic Study, Propellant Burning at Firing Points (CS-18), Massachusetts Military Reservation, MA.* Prepared by U.S. Army Center for Health Promotion Medicine and preventive medicine, Aberdeen Proving Ground, MD.

USAEHA. 1987 (September). *Interim Report, Hazardous Waste Study No. 37-26-0165-87, Investigation of Soil Contamination from Propellant Burns, Camp Edwards Massachusetts, 25-29 June and 14-15 July 1987.* Prepared by U.S. Army Center for Health Promotion Medicine and preventive medicine, Aberdeen Proving Ground, MD.

______. 1999 (January). *Final Report, Human Health Risk Assessment, Open Burning of Propellant Bags, Massachusetts Military Reservation, MA* Prepared by U.S. Army Center for Health Promotion Medicine and preventive medicine, Aberdeen Proving Ground, MD.

3.6.15 Chemical Spill No. 19 (CS-19) Source

A. Background

A.1. Site Description. The CS-19 Study Area is located in the west-central region of the MMR Impact Area (Figure 1-1). Currently, the CS-19 Study Area has a soil and groundwater component. The CS-19 Study Area contains an inactive site used historically for ordnance disposal; it measures approximately 3 acres in size and appears to be comprised of a testing area and a disposal area.

The magnetic anomalies were shown to be buried ordnance and metallic debris from ordnance and waste disposal. Surface soil and subsurface soil at the CS-19 study area contain a variety of nonvolatile contaminants, including SVOCs, metals, explosives, dioxins/furans, pesticides, and herbicides.

A.2. Initial Responses. Not applicable.

A.3. Basis for Taking Action. Environmental restoration at CS-19 is following the CERCLA removal action process. Previous investigations (SI and RI) have shown the site to be a continuing source of RDX contamination to groundwater.

<u>1991 Preliminary Assessment</u>: A PA performed in 1991 was based on historical aerial photograph review and interviews with six personnel. The findings of the PA suggested that CS-19 was historically used as an ordnance and military waste disposal site. Liquid wastes from unknown sources were reportedly disposed at the site, and the study area was reported to contain buried unexploded ordnance (UXO) and rocket bodies due to both firing and possible test range ordnance disposal activities.

<u>1992 Site Assessment</u>**:** The ANG conducted a site assessment in 1992, which included a geophysical survey and excavation and sampling of test pits. The test pit excavations uncovered large quantities of buried ordnance debris. The site assessment concluded that

the contaminants detected in soil (principally phthalates, amines, nitroaromatics, and inorganics) were consistent with the hypothesis that the study area was used for ordnance disposal. Pesticides and herbicides were also detected in the soil, but at low concentrations.

2000-2003 Remedial Investigation: The RI activities for CS-19 soil involved numerous field programs conducted from 1999 to 2003 (AFCEE 2003). During the RI, surface and sub-surface soil sampling indicated that concentrations of contaminants decreased rapidly with depth and were primarily limited to the study area within the perimeter road. Soil at the CS-19 study area was found to contain a variety of nonvolatile contaminants, including SVOCs, metals, explosives, dioxins/furans, pesticides, and herbicides. Identities and concentrations of contaminants in soil detected during the initial RI were similar to those found in previous investigations. An RDX groundwater plume originating at CS-19 was also delineated as part of the RI.

The RI concluded that although there is potential human health risk due to RDX and arsenic in the soils, the soils do not present a threat because there is no completed exposure pathway as the CS-19 area is precluded from residential development. Use of the site is restricted due to the current land being leased to the military, and because the area has been designated as a groundwater protection area managed by the Environmental Management Commission which oversees all activity in the Impact Area to insure protection of the drinking water supply and wildlife habitat. Access to the MMR is restricted to military personnel and individuals who have business on the base and have been cleared by the military. Furthermore, an additional layer of restrictions is in place around the Impact Area of MMR, including locked gates at all access roads leading into the Impact Area. With the exception of explosives, contaminants still present in soil at the CS-19 study area possess a low mobility due to adsorption or low solubility under the slightly acidic groundwater conditions. Modeling results predict that the existing RDX groundwater plume from CS-19 will dissipate if the source of leachate is removed (i.e., the current plume will disperse and dilute below health advisory (HA) limits without

a sustained source). As a result, AFCEE and the regulatory agencies agreed to remove the RDX-contaminated soil at CS-19.

<u>November 2003 Geophysical Survey</u>: A geophysical investigation was performed in November 2003 and encompassed the one acre of CS-19 source area within the perimeter road. To facilitate the geophysical survey, remaining scrub brush within the perimeter road was removed. Munitions of Explosive Concern (MEC) scrap and non-MEC related items discovered during this investigation and those from previous investigations were relocated to the Central Impact Area (CIA) scrap pile on Wheelock Road. MEC items consisted mainly of 2.75-inch rocket containers, rocket fins and rocket motor bodies. One 155-millimeter expended training/spotter projectile was located on the ground surface.

The results of the geophysical survey concluded that metal is distributed over much of the site with larger concentrations of metal objects in areas that were previously vegetated.

<u>2004 Data Gap Investigation</u>: The August 2004 sampling effort focused on providing perchlorate data and additional RDX characterization of the source area soils. Samples were collected from the surface and down to 4 ft bgs at 25 locations within the areas that were previously covered with vegetation, with the assumption that these areas were least disturbed and most representative of site conditions. The sampling area for this investigation covered approximately one third of the area within the Perimeter Road. The data collected from the data gap investigation support the conclusions from the RI that the RDX detections are associated with Discarded Military Munitions (DMM) and UXO. Perchlorate was not detected in any of the soil samples.

<u>June 2005 Engineering Evaluation/Cost Analysis</u>: The CS-19 EE/CA (AFCEE 2005) presents three removal action alternatives. Alternative A (No Action) does not meet RAOs developed for this site and does not mitigate leaching of RDX into groundwater. There is no cost associated with implementing this alternative. Alternative B (On-Site

Treatment) and Alternative C (Off-Site Disposal) meet removal action objectives developed for the site and comply with ARARs.

Alternative B (On-Site Treatment) was selected as the removal action alternative for CS-19 Soil. Alternative B (On-Site Treatment) satisfies the statutory preference for treatment that ultimately destroys the contamination. Alternative B (On-Site Treatment) was also slightly less expensive than Alternative C (Off-Site Disposal). This cost was lower due to the Army having a treatment system mobilized to the site for other work. The removal action has actually included a combination of on-site treatment and off-site disposal.

B. Remedial/Removal Actions

This section presents the regulatory actions, RAOs, and remedy description for the CS-19 source area.

B.1. Regulatory Actions.

Action Memorandum: A draft AM (AFCEE 2006) for the CS-19 source area was developed in May 2006. This document has not been finalized since the scope of the removal work has continued to grow as described in Section B.4.

B.2. Removal Action Objectives. A non time critical removal action has been identified in the draft AM with the objective of removing RDX in soil to prevent further leaching to groundwater.

B.3. Remedy Description. The remedy described in the draft AM calls for soil excavation, on-site treatment, confirmation sampling, and restoration. The basis for the removal action for RDX-contaminated soil at CS-19 is to mitigate further degradation of the underlying aquifer. As described below, the site yielded tons of munitions debris

(MD) and numerous UXO items. The remedy being implemented includes both on-site treatment and off-site disposal.

B.4. Remedy Implementation.

Phase I: The removal action work at CS-19 began in August 2004 as 546 magnetic anomalies identified in earlier electromagnetic surveys were excavated. The goal was to remove the first two feet of debris and soil in order to conduct further electromagnetic surveys and was termed Phase I. This anomaly removal operation produced 4,932 pounds (lbs) of MD and approximately 200 lbs of range related debris (RRD). Additionally, 35 UXO items were blown in place (BIP) and 15 items were sent to the Confined Detonation Chamber (CDC). There were 2,000 cubic yards of soil removed during this phase that were subsequently treated in a Thermal Treatment Unit and stockpiled on site. Also, a DMM burial pit was identified for later action.

Phase II: Additional EM-61 surveys and subsequent removal progressed through March 2006. There were 1,396 targets investigated and four burial pits discovered resulting in the removal of 12,651 lbs of MD, 8,029 MECs recovered for disposal in the CDC, and 25 items that required BIP. There were 734 cubic yards of soil stockpiled for future disposal.

Phase III: From March 2006 to December 2006 the investigation/removal expanded to the west beyond the boundary of the perimeter road (which was thought to define the extent of the site). In this phase, 111 polygons were defined (vs. individual targets) resulting in the removal of 10,183 lbs of MD, 570 MECs recovered for disposal in the CDC, and 38 items that required BIP.

After completion of the removal actions described above, the disposal site was divided into 50-foot by 50-foot grids and sampled for explosives, perchlorate, and metals. At the time of this five-year review, additional removal actions (including non-treated soil stockpiles) are being planned for the CS-19 disposal area.

An additional investigation is being conducted of the area directly to the north of the CS-19 disposal area. This area contains a munitions testing area and is being included as part of the CS-19 site and has been termed the CS-19 Bunker Area. An initial investigation (AFCEE 2008) was conducted in 2007 and discovered a burial pit, test stands, and numerous detonation pits. No conclusive data has been collected that show this area to be a significant source of contamination to groundwater. At the time of this five-year review, additional investigation of the Bunker Area is being planned for 2009.

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review.

- Final CS-19 Remedial Investigation Report (AFCEE 2003)
- Final CS-19 EE/CA (AFCEE 2005)
- Draft CS-19 AM (AFCEE 2006)
- Multiple Removal Actions as documented in the CS-19 Source Area Interim Report (AFCEE 2007)
- Investigation of the CS-19 Bunker Area as described in the CS-19 Bunker Area Investigation Report (AFCEE 2008)

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

This question is not applicable since the remedy outlined in the draft AM is still underway.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: Since the time of the draft AM, the MassDEP has added a new GW-1 standard to the MCP for RDX of 1 µg/L, effective February 2008. This new standard does not alter the removal action approach being taken.

Changes in Exposure Pathways: Evaluations regarding leaching ability of other explosives are being conducted as part of the Impact Area investigations at the MMR. CS-19's final remediation will have to address these other constituents in addition to RDX.

Changes in Toxicity and Other Contaminant Characteristics: No changes.

Changes in Risk Assessment Methods: No changes.

Review of RAOs: The current objective of removing the source of the RDX plume is valid. The Final AM will have to address the objectives of preventing leaching of other explosive constituents (e.g., DNT, TNT, nitroglycerine).

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues

AFCEE and regulatory agencies have agreed to clean up the source area soil contamination by conducting a non-time critical removal action focusing on eliminating the source of the RDX plume. Final remediation will have to account for other explosives as described above.

F. Recommendations and Follow-Up Actions

The recommendations and follow-up actions include finalizing the CS-19 disposal area removal action and bunker area investigation and subsequent removal action (if required) to include addressing other explosive compounds.

G. Protectiveness Statement

CS-19 is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled. CS-19 source area is undergoing a removal action and is located in a portion of the MMR which is restricted in access, therefore it is protective in the short-term for human health and the environment under the current exposure scenarios.

H. References

AFCEE. 2008 (April). *CS-19 Bunker Area Investigation Report*. Prepared by AMEC Earth and Environmental, Inc for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

______. 2007 (February). *CS-19 Source Area Interim Report*. Prepared by Environmental Chemical Company for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

______. 2006 (May). *Draft Chemical Spill No.19 (CS-19) Action Memorandum.* Prepared by Portage Environmental, Inc for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

______. 2005 (June). *Final Chemical Spill No.19 (CS-19) Engineering Evaluation/Cost Analysis (EE/CA)*. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

______. 2003 (October). *Final Chemical Spill-19 Remedial Investigation Report.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.16 Chemical Spill No. 22 (CS-22) Source

A. Background

A.1. Site Description. AOC CS-22 is approximately 17.25 acres located near the east-central portion of MMR (Figure 1-1). The site consists of a former sand and gravel borrow pit located west of Greenway Road and south of Dolan Road near the MMR access gate (Sandwich Gate) at the northeastern end of Snake Pond Road in Sandwich, Massachusetts.

A.2. Initial Response. During the spring of 2000, the Camp Edwards Environmental Protection Office supervised the removal of approximately 418 tons of soil from the petroleum contaminated soil area in the northern portion of AOC CS-22. Soil removed from the site was stockpiled at a fenced and locked compound at Camp Edwards prior to removal from the installation. The stockpile was subsequently transported by truck to American Reclamation Corp., a MassDEP-licensed soil recycling facility in Charlton, Massachusetts.

A.3. Basis for Taking Action. AOC CS-22 followed the CERCLA SI process. Described below is a summary of site characterization activities and removal action alternatives analyzed for cleanup at AOC CS-22.

<u>Preliminary Assessment</u>: A PA was completed for the AOC CS-22 in 1999 (AFCEE 2000). The PA identified an area of petroleum-contaminated soil near the northwest end of the gravel pit and 11 small debris areas, most of which are concentrated near the southeast end of the gravel pit. The debris areas contained miscellaneous refuse consisting primarily of construction/demolition debris, asphalt and household waste. Prior to the PA, previous site work consisted of the collection and analysis of two soil samples from the northern portion of the petroleum-contaminated soil area in March 1999.

<u>CS-22 Pre-EE/CA Soil Sampling Letter Report</u>: Additional sampling was performed to further delineate petroleum contamination and PAH contamination at AOC CS-22 in 2001. For the purposes of this effort, AOC CS-22 was divided into a northern portion and a southern portion. The scope of work for the northern portion of the site included the collection of 12 surface soil samples from six locations around the perimeter of the southern end of the previous excavation completed in 2000. Samples were analyzed for EPH using the MassDEP methodology. No concentrations of EPH were above respective MCP Method 1 S-1/GW-1 Standards. The scope of work for the southern portion of the site included the collection of 83 soil samples from 41 locations. These samples were analyzed for total carcinogenic PAHs using an on-site immunoassay field screening method. Thirteen of the 83 soil samples that were field-screened were also submitted for laboratory analysis of individual PAH compounds. Four of the soil samples contained levels of individual PAH compounds in excess of applicable MCP Method 1 S-1/GW-1 soil standards (AFCEE 2001b).

<u>Site Investigation</u>: The objectives of the CS-22 SI were to provide confirmatory sampling of the petroleum-contaminated soil excavation; determine if waste materials associated with debris areas elsewhere in the gravel pit had contributed to soil contamination; determine if groundwater beneath the site is captured by the existing CS-10 ETR systems; determine if a potential risk to human health or ecological receptors exists; and determine appropriate follow-on actions (AFCEE 2001a). The soil analytical results were compared to MCP Method 1 S-1/GW-1 soil standards and EPA Region IX Residential PRGs. Based on the results of the SI, representatives from the EPA, MassDEP and AFCEE agreed in March 2001 that AFCEE should proceed with an EE/CA to address soil contaminated with petroleum hydrocarbons and PAHs at AOC CS-22. It was also agreed that no further groundwater investigation was required.

A human health PRE was completed as part of the SI. Analytes were compared to EPA Region IX Residential PRGs and MassDEP S-1/GW-1 standards. Several metals and organic compounds were selected as COPCs. In order to be consistent with removal and

remedial actions for the SARAP, AFCEE selected human health risk-based COCs based on the comparison of analytical data of COPCs selected by the SI with the most stringent human health risk-based STCLs developed during the DSRP. The human health COCs selected were: aluminum, arsenic, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, C_{11}-C_{22} aromatic hydrocarbons, C_{19}-C_{36} aliphatic hydrocarbons, dibenz(a,h)anthracene, and indeno(1,2,3-c,d) pyrene. An ecological PRE was completed to evaluate potential ecological risks associated with exposure to contaminated surface soil (zero to 2 ft bgs). Results of the PRE triggered the need for an evaluation of removal action alternatives (i.e., EE/CA). The COCs identified at AOC CS-22 were aluminum, arsenic, barium, chromium, lead, selenium, vanadium, and benzo(a)pyrene.

<u>Engineering Evaluation/Cost Analysis</u>: An EE/CA was completed for AOC CS-22 in March 2002 (AFCEE 2002b). The following three alternatives received detailed analysis in the EE/CA:

- Alternative 1: No Action
- Alternative 2: Institutional Controls and Soil and Groundwater Modeling
- Alternative 3: Excavation, Off-site Disposal and Site Restoration

B. Remedial/Removal Actions

This section presents the regulatory actions, RAOs, a description of the selected removal action, and a summary of the removal action implementation at AOC CS-22.

B.1. Regulatory Actions.

<u>Action Memorandum</u>: The CS-22 AM (AFCEE 2002a) documented the decision to perform removal actions at AOC CS-22. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 3 which included excavating soil contaminated with COCs above removal action levels, and staging the soil for off-site transportation to an appropriately licensed landfill for disposal.

Action Memorandum Addendum: The CS-22 AM Addendum (AFCEE 2003a) provided corrections to RALS for several ecological risk-based COCs.

B.2. Removal Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet removal response objectives. Based on this comparison, the following RAOs were established for AOC CS-22:

- Protect ecological and human receptors at AOC CS-22 by mitigating direct exposure to soil contaminated with metals, petroleum hydrocarbons, and PAHs which may pose unacceptable risk, and
- Mitigate potential impact to groundwater by petroleum hydrocarbons.

Cleanup based on the following COCs with their respective RALs were used to meet the RAOs established for AOC CS-22.

Table B-1
COCs and Respective RALs for CS-22

COC	Cleanup Level (mg/kg)	Basis
Aluminum	8,900	Ecological
Arsenic	3.6	Human
Barium	52	Ecological
Chromium	19	Ecological
Lead	99 (0-2 ft bgs)	Ecological
	300 (>2 ft bgs)	Human
Selenium	0.33	Ecological
Benzo(a)anthracene	0.7	Human
Benz(o)pyrene	0.625 (0-2 ft bgs)	Ecological
	0.7 (>2 ft bgs)	Human
Benzo(b)fluoranthene	0.7	Human
Dibenz(a,h)anthracene	0.7	Human
Indeno(1,2,3,-c,d)pyrene	0.7	Human

Table B-2 MassDEP S-1/GW-1 Standards for Petroleum Hydrocarbons	
Type of Petroleum Hydrocarbons	**RAL (mg/kg)**
Aliphatic Hydrocarbons	
C_{19} through C_{36} Aliphatic Hydrocarbons	2,500
Aromatic Hydrocarbons	
C_{11} through C_{22} Aromatic Hydrocarbons	200

B.3. Removal Action Implementation. AFCEE completed the removal action in 2002. Removal action activities and results of confirmatory sampling were documented in a RAR which was prepared in 2003 (AFCEE 2003b). Approximately 1,115 cubic yards of contaminated soil were removed from AOC CS-22. Confirmatory sampling results indicated that the contaminant concentrations in soil were below the RALs. Excavated soil was transported to a central bulking facility located on the MMR. Soil from AOC CS-22 was combined with soil from other sites. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. The consolidated soil was disposed of at the North Carver Landfill in North Carver, Massachusetts. Disposal activities were performed in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MassDEP 1997).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review:

- Removal action activities and results of confirmatory sampling were documented in a RAR which was completed in 2003 (AFCEE 2003b).
- AOC CS-22 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the EE/CA, AM, and AM Addendum. The excavation and offsite disposal of contaminated soil has achieved the RAOs of mitigating the migration of contaminants to groundwater and preventing direct contact with, or ingestion of contaminants in soil.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: MassDEP has re-evaluated S-1/GW-1 soil standards since the finalization of the AM and implementation of the removal action at COC CS-22. The new S-1/GW-1 soil standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. The MassDEP S-1/GW-1 soil standards for C_{19} through C_{36} aliphatic hydrocarbons, C_{11} through C_{22} aromatic hydrocarbons, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene have increased. No cleanup levels for chemical compounds identified as COCs for CS-22 decreased numerically during this five-year period. The new MassDEP S-1/GW-1 soil standards do not change the protectiveness of the implemented removal action.

EPA Region IX also revised PRGs in 2004. California State values were added to the PRG table for lead and arsenic, which were identified as human health COCs at AOC CS-22. The PRG update does not affect the protectiveness of the removal action.

Changes in Exposure Pathways: There have been no changes in the physical conditions or exposure pathways that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics: MassDEP has re-evaluated S-1/GW-1 standards for EPH/VPH since the last five-year review. The MassDEP S-1/GW-1 standards are based on unrestricted use and take into consideration dermal exposure, ingestion exposure, and impact to groundwater.

EPA Region IX also revised PRGs in 2004. California State values were added to the PRG table for lead and arsenic, which were identified as human health COCs at AOC CS-22. The PRG update does not affect the protectiveness of the removal action.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the implemented removal action.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no information that calls into question of the protectiveness of the selected removal action.

E. Issues

None.

F. Recommendations and Follow-Up Actions

None.

G. Protectiveness Statement

The remedy selected for AOC CS-22 (source control including excavation and off-site disposal) protects human health and the environment because the removal actions

achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing concentrations of COCs above RALs has been removed. No land-use restrictions are required for the site and the site no longer requires a five-year review.

H. References

AFCEE. 2003a (July). *Final Chemical Spill No. 22 (CS-22) Action Memorandum Addendum.* Prepared by Engineering Strategies Corporation and Portage Environmental for AFCEE/MMR Installation Restoration Program.

_____. 2003b (July). *Final Removal Action Report Area of Contamination Chemical Spill No. 22 (CS-22).* Prepared by Engineering Strategies Corporation and Portage Environmental for AFCEE/MMR Installation Restoration Program.

_____. 2002a (May). *Chemical Spill No. 22 (CS-22) Action Memorandum (AM).* Prepared by Engineering Strategies Corporation and Portage Environmental for AFCEE/MMR Installation Restoration Program.

_____. 2002b (March). *Chemical Spill No. 22 (CS-22) Engineering Evaluation/Cost Analysis (EE/CA).* Prepared by Engineering Strategies Corporation and Portage Environmental for AFCEE/MMR Installation Restoration Program.

_____. 2001a (October). *Final Chemical Spill-22 Site Investigation*, AFC-J23-35U41202-M13-0005. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2001b (October). *Chemical Spill-22 Pre EE/CA Soil Sampling Letter Report.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2000 (March). *Final Preliminary Assessments for Chemical Spill-8 Coast Guard and Chemical Spill-22.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

MassDEP. 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001.*

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.17 Coal Yard No. 1 (CY-1) and Coal Yard No. 3 (CY-3) Source

A. Background

A.1. Site Description. Study Area CY-1 is a former U.S. Army coal storage area that was used from 1940 to 1957. Study Area CY-1 is located east of Turpentine Road and south of Lee Road in an area now occupied by the base theater, barracks, and athletic fields (Figure 1-1). When Study Area CY-1 was in use, coal was unloaded from railroad cars and stockpiled along two rail sidings on the western side of the rail spur leading to the quartermaster area north of Lee Road. Coal was transported from Study Area CY-1 to individual power plants. Base drawings and aerial photographs indicated that the coal piles may have extended over 1,000 feet along the sidings. A coal weigh station and smaller coal piles were located on a rail siding east of the rail spur. The rail sidings at Study Area CY-1 have been removed, along with all visible evidence of former coal storage activities. The area is now vegetated, paved, and occupied by buildings.

Study Area CY-3 is located at the site of the former Veterans Administration hospital steam plant at the corner of East Hospital and West Hospital roads (Figure 1-1). The steam plant was in operation from 1945 to 1972. Coal was stored on an unbermed, paved pad before transfer to hopper bins. Coal ash was stored temporarily in an on-site pit. The pit was cleaned out every one or two months and the ash was taken to the MMR landfill. All stockpiled coal and ash have been removed from Study Area CY-3.

A.2. Initial Response

Not applicable.

A.3. Basis for Taking Action

<u>Preliminary Assessment</u>: As part of the Phase I IRP investigations, a Records Search/PA was conducted at CY-1 and CY-3 in 1986. In 1962, water supply Well B, located

approximately 600 feet east of the weigh station and 1,200 feet east of the main coal storage area, was closed because of contamination by phenolic compounds. Because phenols can be constituents of coal pile leachate; the source of these compounds in Well B, as stated in the records search, was originally suspected to be Study Area CY-1 (E.C. Jordan Co. 1986). However, because groundwater flow direction in this region of MMR is south-southwesterly water supply Well B was not believed to be located downgradient of Study Area CY-1. Analysis of two rounds of water samples from Well B collected in 1986 did not detect VOCs, SVOCs, or inorganics of concern (E.C. Jordan Co. 1987).

Gated Approach: In 1990, the National Guard Bureau, the EPA, and the MassDEP agreed to a "gated" approach for determining remedial activities at CY-1 and CY-3, meaning that findings and conclusions from investigations of coal storage yards CY-2 and CY-4 would be used to support a decision document for CY-1 and CY-3. The reasoning for this approach was based on a Phase I study at the MMR which concluded that each of the four coal yards at MMR had similar operational histories. Following the Phase I investigation, Phase II studies were recommended for Study Area CY-2, where a site assessment was conducted, and for AOC CY-4, where a site inspection and remedial investigation were conducted.

CY-2 Site Investigation: The purpose of the SI was to determine whether coal pile leachate at CY-2 had affected on-site soil or groundwater quality. Results of the site assessment indicated that CY-2 does not pose a threat to human health or groundwater quality (E.C. Jordan Co. 1988a).

CY-2 is located less than 1,000 feet from the southern MMR boundary at the corner of Kittredge Road and Generals Boulevard (Figure 1-1). Study Area CY-2 is the location of the Upper Cape Regional Transfer Station (UCRTS). Coal was stockpiled at CY-2 from 1957 to 1984. Most of the coal was piled on a bituminous paved surface. Runoff from the coal piles was channeled into storm drains that discharged onto the ground at the northern and southern corners of the pave areas. A natural northeast-southwest trending drainage swale is located at the south-eastern section of the site, which extends south of

the MMR boundary. The swale has been interrupted, just inside the MMR boundary, by fill along the right-of-way of Kittredge Road.

Fifteen surface soil samples were collected from the perimeter of the paved area, drainage swales, and along the railroad spurs at the location of the proposed waste tipping platform. The samples were analyzed for SVOCs and inorganic chemicals. VOCs were not analyzed based on the site history. Surface soils at CY-2 contained trace levels of PAHs related to the edge of the pad where coal eroded from the pad. Arsenic was detected (88 mg/kg) in one of the storm drain outfall areas.

Nine subsurface soil samples were collected for analysis. Three samples from each boring were analyzed for VOCs, SVOCs, pesticides and PCBs, cyanide and metals. Samples were collected at each boring from shallow unsaturated (5 to 10 feet), intermediate unsaturated (25 to 30 feet), and saturated (50 to 55 feet) soils. With the exception of the anomalous result for the 53-foot depth at TB-2, no significant subsurface soil contamination was observed at CY-2 (i.e., at borings TB-1, TB-2, and MW-3). The PAHs found at the water table elevation in TB-2 were not accompanied by similar or higher levels in the soil layers above it.

One groundwater sample was collected from MW-3 in September 1987, and five groundwater samples were collected from the MW604 cluster in October 1987 and then again in January 1988. Samples were analyzed for VOCs, SVOCs, and inorganics. No significant site-related groundwater contamination was detected (E.C. Jordan Co. 1988a).

<u>CY-2 Decision Document</u>: The CY-2 Decision Document completed in October 1998, documented that there was no evidence of significant environmental risk at the CY-2 site, and that the decision was made to remove this site from further consideration in the IRP process. The Massachusetts Department of Environmental Quality Engineering (DEQE) concurred with the document in January 1998; however the EPA has yet to concur. The SI and Decision Document were reviewed by the Massachusetts DEQE. In their response

letter to the SI, the DEQE agreed with the assessment that the site does not pose a health hazard to humans involved in the construction or operation of the regional solid waste transfer station proposed for the location. The DEQE suggested that further limited investigations be conducted to clarify two issues. A test pit was dug in the area and a soil sample from 3 to 5 feet was obtained. This sample was analyzed for SVOCs; none were detected. The results of this analysis were consistent with those obtained earlier (E.C. Jordan Co. 1988b).

U.S. Geological Survey Plume Study: The USGS installed several monitoring wells south of the MMR boundary to monitor the migration of contaminants from the MMR Sewage Treatment Plant. One of the monitoring wells, labeled FSW-234, is located in the town of Falmouth approximately 1,800 feet south of Study Area CY-2. It was sampled by the USGS in 1983 and analyzed for inorganics. Several inorganics were detected; however, the concentrations were all below federal and state drinking water standards (LeBlanc 1984).

Remedial Investigation of AOC CY-4: Field activities conducted at AOC CY-4 and reported in the remedial investigation report included collection of subsurface soil samples from seven soil borings, surface soil samples from an area of coal ash and soot disposal, and two ash samples (AFCEE 1996). AOC CY-4 is located approximately 400 feet south of the Central Heating Plant on Granville Road near the southeastern corner of MMR. Coal was stockpiled at AOC CY-4 from 1955 to 1990; from 1955 to 1978, it was stored directly on the ground, before installation of a concrete pad. Runoff from AOC CY-4 drained to Storm Drainage Ditch No. 3 (SD-3) along with runoff from upgradient areas. AOC CY-4 includes an area of approximately 8 acres where coal ash and soot were disposed of from 1955 to 1990.

Ash samples were collected at two locations at AOC CY-4 and analyzed for TCL SVOCs and TAL inorganics. The samples were found to contain low concentrations of three SVOCs, 12 inorganics, and several tentatively identified compounds.

Two samples of surficial material (0-2 ft bgs) were collected from the area of ash disposal at AOC CY-4 and analyzed for TCL SVOCs and TAL inorganics. The inorganic data were interpreted as indicating that the surficial samples contained a significant amount of coal ash. The samples did not contain SVOCs above Contract Required Quantitation Limits (CRQLs).

Nineteen subsurface soil samples were collected from below the depth of ash disposal. The VOC 2-butanone and a pesticide were reported in samples from one boring, but were not attributed to coal storage or ash disposal activities. The remaining subsurface samples did not contain TCL VOCs, SVOCs, or pesticides and PCBs above CRQLs. TAL inorganics were below CRDLs in 17 of the 19 subsurface samples. Aluminum was present in two of 19 samples at concentrations representative of background conditions at MMR. The data indicate that although coal ash contains inorganics and low concentrations of SVOCs, contamination of underlying soils has apparently not occurred at AOC CY-4.

A limited supplemental RI was completed in 1993 to address concerns that additional VOC contamination may exist in the SD-3 drainage ditch and at the outfalls of two storm sewers south of the coal storage yard, which had not been previously sampled. The program consisted of collection of three sediment samples. One was collected from the SD-3 drainage ditch and analyzed for VOCs. The other two were collected from the discharge areas of the southern storm sewers and analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL inorganics (AFCEE 1996).

The RI report for AOC CY-4 included a human-health PRA to evaluate potential human-health risks associated with exposure to contaminated surface soil and sediment using trespasser (child) and utility work exposure scenarios and an ecological PRA to evaluate potential ecological risks associated with exposure to contaminated surface soil (0-2 ft bgs) and sediment. The human health PRA calculated cancer risks for utility workers and child trespassers were below EPA and MassDEP target risk range. The conclusions of the ecological PRA were that additional remedial actions do not appear warranted.

Groundwater Assessment: In response to MassDEP comments on the "Draft Decision Document for Study Areas CY-1 and CY-3," a water table monitoring well, MW-1, was installed at Study Area CY-1 in March 1998. Analytical results of samples collected in April 1998 from MW-1 did not detect groundwater contamination. Details of the groundwater assessment at Study Area CY-1 are presented in Appendix A of the "Final Decision Document for Study Areas CY-1 and CY-3" (AFCEE 2003a).

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area CY-1/CY-3.

Decision Document: The CY-1/CY-3 Decision document completed in January 2003 (AFCEE 2003a), documented the decision to remove Study Area CY-1 and Study Area CY-3 from further consideration in the IRP process. The determination was based on the findings at Study Area CY-2 and AOC CY-4, and additional surface soil and groundwater sampling conducted at Study Area CY-1 and surface soil sampling conducted at CY-3. The determination stated that there is no evidence or reason to conclude that historical coal or ash storage activities at Study Areas CY-1 and CY-3 have caused significant environment contamination or pose a threat to human health or the environment.

In 1990, the National Guard Bureau, the EPA, and the MassDEP agreed to a "gated" approach for determining remedial activities at CY-1 and CY-3, meaning that findings and conclusions from investigations of coal storage yards CY-2 and CY-4 would be used to support a decision document for CY-1 and CY-3. The reasoning for this approach was based on a Phase I study at the MMR which concluded that each of the four coal yards at MMR has similar operational histories.

Study Area CY-2 has been characterized and found not to pose a threat to human health or groundwater quality by regulatory agencies. Coal ash that was disposed of at AOC CY-4 has been shown not to be contaminating underlying soils. Any environmental impacts from

past storage of coal or coal ash at Study Areas CY-1 and CY-3 is expected to be far less than any impact from coal storage at Study Area CY-2 or coal/ash storage at AOC CY-4. Analytical results from both the surface soil investigation at Study Areas CY-1 and CY-3, and the groundwater investigation at CY-1 support the recommendation for no further action at Study Areas CY-1 and CY-3.

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- Final Study Areas Coal Yard-1 (CY-1) & Coal Yard-3 (CY-3) Decision Document: Completed January 2003 (AFCEE 2003a).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The remedy is functioning as intended by the Decision Document.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: No cleanup was performed at this site. Samples collected in CY2001 were analyzed for arsenic, chromium, lead, vanadium, and zinc and compared to SARAP ecological-risk based RALs. No chemicals were detected above RALs. All SARAP ecological-risk based RALs with the exception of Arsenic are more stringent than current (CY2007) ORNL RAIS residential PRGs. The ORNL RAIS worker PRG is more stringent than the background. Arsenic was detected only in three of 16 samples slightly above background. Because of low detection frequency and

relatively low concentrations of chemicals detected; the no further action remains protective.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedial action

Changes in Toxicity and Other Contaminant Characteristics: ORNL RAIS PRGs for arsenic was revised; however there was no impact on no further action based on a worker exposure scenario.

Changes in Risk Assessment Methods: Not Applicable.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the no further action for CY-1/CY-3 Source (soil) based on current land use. Portions of this IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Evaluate requirements to determine unrestricted use for the site.

G. Protectiveness Statement

The no further action decision for this site protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios.

H. References

AFCEE. 2003a. *Final Study Areas Coal Yard 1 (CY-1) and Coal Yard 3 (CY-3) Decision Document*; Installation Restoration Program, Massachusetts Military Reservation; January 2003.

______. 2003b (February). *Explanation of Significant Differences Areas of Contamination CS-10 (A,B,&C); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; and SD-3/FTA-3/CY-4.* Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2000 (December). *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 1996. "Remedial Investigation for the Storm Drainage Ditch No. 3, Former Fire-Training Area No. 3, and Coal Yard No. 4 (SD-3/FTA-3/CY-4 Study Area)"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; November 1996.

E.C. Jordan Co. 1988a (August). *Task 2-3 Site Assessment of Coal Yard 2 (CY-2)*. Prepared for ANG by E.C. Jordan, Co., Portland, Maine.

______. 1988b (October). *Decision Document Site Coal Yard-2*. Prepared by E.C. Jordan, Co., Portland, Maine. Prepared for National Guard Bureau, Andrews Air Force Base, MD.

______. 1986. "U.S. Air Force Installation Restoration Program, Phase I: Records Search, Air National Guard, Camp Edwards (ARNG), U.S. Air Force and Veterans Administration Facilities at Massachusetts Military Reservation: Task 6"; prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee; December 11, 1986.

______. 1987. "Water Supply Study at Massachusetts Military Reservation, Task 3-1"; Installation Restoration Program; Massachusetts Military Reservation; prepared for HAZWRAP; Portland, Maine; April 15, 1987.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

LeBlanc, D.R. (Editor), 1984. "Movement and Fate of Solutes in a Plume of Sewage-Contaminated Groundwater, Cape Cod, Massachusetts: U.S. Geological Survey Toxic Waste Groundwater Contamination Program"; presented at the Toxic Waste Technical Meeting; Tucson, Arizona; March 20-22, 1984; U.S. Geological Survey Open-File Report 84-475.

3.6.18 Coal Yard No. 2 (CY-2) Source

A. Background

A.1. Site Description. CY-2 is located less than 1,000 feet from the southern MMR boundary at the corner of Kittredge Road and Generals Boulevard (Figure 1-1). Study Area CY-2 is the location of the UCRTS which is owned via an inter-municipal agreement between the towns of Bourne, Falmouth, Mashpee, and Sandwich. A Board of Managers was established with representatives from all four towns and a representative from the 102nd ANG to provide oversight of the UCRTS.

Coal was stockpiled at CY-2 from 1957 to 1984. Most of the coal was piled on a bituminous paved surface. Runoff from the coal piles was channeled into storm drains that discharged onto the ground at the northern and southern corners of the pave areas. A natural northeast-southwest trending drainage swale is located at the south-eastern section of the site, which extends south of the MMR boundary. The swale has been interrupted, just inside the MMR boundary, by fill along the right-of-way of Kittredge Road.

A.2. Initial Response

Not applicable.

A.3. Basis for Taking Action

Preliminary Assessment: As part of the Phase I IRP investigations, a Records Search/PA was conducted at CY-2 in 1986. The potential site contaminants listed were all components of coal pile leachate and included metals, sulfates, acid, and PAHs. Based on the findings from the Phase I investigation, a Phase II Confirmation/Quantification Study was recommended.

Confirmation/Quantification Study: A Phase II Confirmation/Quantification Study was conducted at the site in 1988. A groundwater sample from the USGS Well FSW-234 was

analyzed to determine groundwater quality south of CY-2 and the MMR boundary. Volatile and semivolatile organics were not detected in the groundwater sample. Metals were detected, but not in concentrations which exceeded the MCP GW-1 standards.

Site Investigation: The purpose of the SI was to determine whether coal pile leachate at CY-2 had affected on-site soil or groundwater quality (E.C. Jordan Co. 1988a).

Fifteen surface soil samples were collected from the perimeter of the paved area, drainage swales, and along the railroad spurs at the location of the proposed waste tipping platform. The samples were analyzed for SVOCs and inorganic chemicals. VOCs were not analyzed based on the site history. Surface soils at CY-2 contained trace levels of PAHs related to the edge of the pad where coal eroded from the pad. Arsenic was detected (88 mg/kg) in one of the storm drain outfall areas.

Nine subsurface soil samples were collected for analysis. Three samples from each boring were analyzed for VOCs, SVOCs, pesticides and PCBs, cyanide and metals. Samples were collected at each boring from shallow unsaturated (5 to 10 feet), intermediate unsaturated (25 to 30 feet), and saturated (50 to 55 feet) soils. With the exception of the anomalous result for the 53-foot depth at TB-2, no significant subsurface soil contamination was observed at CY-2 (i.e., at borings TB-1, TB-2, and MW-3). The PAHs found at the water table elevation in TB-2 were not accompanied by similar or higher levels in the soil layers above it.

One groundwater sample was collected from MW-3 in September 1987, and five groundwater samples were collected from the MW604 cluster in October 1987 and then again in January 1988. Samples were analyzed for VOCs, SVOCs, and inorganics. No significant site-related groundwater contamination was detected (E.C. Jordan Co. 1988a).

Decision Document: The CY-2 Decision Document completed in October 1998, documented that there was no evidence of significant environmental risk at the CY-2 site, and that the decision was made to remove this site from further consideration in the IRP

process. The Massachusetts DEQE concurred with the document in January 1998; however the EPA has yet to concur. The SI and Decision Document were reviewed by the Massachusetts DEQE. In their response letter to the SI, the DEQE agreed with the assessment that the site does not pose a health hazard to humans involved in the construction or operation of the regional solid waste transfer station proposed for the location. The DEQE suggested that further limited investigations be conducted to clarify two issues. A test pit was dug in the area and a soil sample from 3 to 5 feet was obtained. This sample was analyzed for SVOCs; none were detected. The results of this analysis were consistent with those obtained earlier (E.C. Jordan Co. 1988b).

B. Remedial/Removal Actions

Not applicable.

C. Progress Since the Last Five-Year Review

No actions have been taken at CY-2 since the last five-year review.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

To be determined. EPA has not concurred with the Decision Document.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been no changes in standards and to-be considered.

Changes in Exposure Pathways: There have been no changes in the physical conditions and exposure pathways of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There were no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: Not applicable.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., industrial). However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

(1) EPA has not concurred with the Decision Document.

(2) As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

(1) EPA needs to review Decision Document.

(2) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based

on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

E.C. Jordan Co. 1988a (August). *Task 2-3 Site Assessment of Coal Yard 2 (CY-2)*. Prepared for ANG by E.C. Jordan, Co., Portland, Maine.

______. 1988b (October). *Decision Document Site Coal Yard-2*. Prepared by E.C. Jordan, Co., Portland, Maine. Prepared for National Guard Bureau, Andrews Air Force Base, MD.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.19 Drum Disposal Operable Unit (DDOU) Source

A. BACKGROUND

A.1. Site Description. AOC DDOU is approximately 0.25 acres, and is located in the southeast corner of the Cantonment Area near the corners of Simpkins Road and Sandwich Road (Figure 1-1). The DDOU consists of a clearing in a wooded area located southeast of the former MMR STP at AOC CS-16/CS-17. A former sanitary sewer sludge disposal area is located southwest of the DDOU. The ground slope in the area of the DDOU is nearly level with no severe slopes. A trench feature also was observed at the DDOU that contained black sludge-like material.

A.2. Initial Response. The DDOU was discovered as part of the CS-16/CS-17 RI in 1994. A total of 11 drums were observed in the area on the ground surface. Four of the eleven drums contained various volumes of liquid. These four drums were placed in over-pack drums and removed from the site. The remaining seven drums were wrapped in plastic sheeting and also removed. The liquid in the four drums was sampled by the NGB personnel and analyzed for VOCs, pesticides, PCBs, and TPHs. All of the compounds analyzed for were below the detection limits. Upon receipt of these results, NGB personnel disposed of the drums.

Based on the presence of the drums, two surface-soil samples were collected and analyzed as part of the AOC CS-16/CS-17 RI. Results of sample analysis indicated that two surface samples contained pesticides and other analytes. The pesticides, particularly 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, and alpha-BHC, were found at concentrations over 100 mg/kg.

A.3. Basis for Taking Action. Environmental restoration at DDOU followed the CERCLA non-time critical removal action process. Provided below is a summary of investigations performed at the DDOU.

Site Investigation: An SI was completed in December 1994 and was intended to determine the nature and vertical and horizontal extent of contamination at DDOU. The field investigations conducted included: the completion of 24 shallow soil Geoprobe® borings and collection of soil samples for immunoassay DDT kit analysis and confirmatory laboratory analysis, completion of four deep soil borings as monitoring wells and collection of soil samples for Contract Laboratory Program (CLP) analysis, the collection of ten surface soil samples for CLP analyses, and groundwater sampling for CLP analyses.

The SI report identified two areas of soil contamination that contained pesticides above MMR-specific STCLs; one area measuring approximately 60 by 40 feet (Area 1) encompassing drums numbered one through seven, and the other approximately 20 by 50 feet (Area 2) encompassing drums numbered nine through eleven. SVOC and inorganic analytes at concentrations above STCLs were found commingled in the two areas of pesticide contamination. Data from Area 1 indicated 4,4'-DDT concentrations in surface soil as high as 36,000 mg/kg. Additionally, SVOCs and several inorganic analytes, including arsenic, chromium, lead, vanadium, and zinc, were found at concentrations exceeding respective STCLs within area one. At Area 2, concentrations of 4,4'-DDT were reported as high as 4.1 mg/kg. The highest concentrations of 4,4'-DDE and 4,4'-DDD detected in Area 2 were less than 0.1 mg/kg.

None of the four monitoring wells sampled as part of the DDOU investigation contained detectable concentrations of pesticides.

Risk Evaluation Summary: Based on results of the 1994 site evaluation, a soil removal action was recommended to address residual pesticides that were commingled with SVOCs and inorganic analytes. Recommended was a "non-time-critical" soil removal in two areas of the DDOU to a depth of 2 ft bgs. A PRE was not conducted for this study area, however the following COCs were accepted by AFCEE for the DDOU study area as part of the SARAP: 2-chlorophenol, 1,2,4-trichlorobenzene, 2,4-dinitrotoluene,

pentachlorophenol, Phenanthrene, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, arsenic, chromium, lead, vanadium, and zinc.

Engineering Evaluation/Cost Analysis: The DDOU was included as part of the Priority 2 and 3 Study Areas and DDOU EE/CA completed in October 1998 (AFCEE 1998).

The following alternatives received detailed analysis in the EE/CA:

- Alternative 1: On-base Thermal Desorption and Off-base Treatment and Disposal
- Alternative 2: On-base Asphalt Batching and Off-base Treatment and Disposal
- Alternative 3: Off-base Treatment and/or Disposal.

B. Removal Actions

This section presents the regulatory actions, RAOs, a description of the selected removal action, and a summary of the removal action implementation at the DDOU.

B.1. Regulatory Actions. Described below are the controlling documents that present the selected removal action and post-EE/CA documents that identified changes to the selected removal action.

Action Memorandum: The selected removal action documented in the AM (AFCEE 1999) consisted of excavating contaminated soil and treating this material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility. Excavated soil that is found to have contaminant concentrations in exceedance of TCLP allowable concentrations would be deemed hazardous and disposed of off-site in a RCRA Subtitle C TSDF. Soil that is found to have contaminant concentrations below TCLP allowable concentrations (and that have contaminant concentrations below MassDEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be deemed nonhazardous and be treated at the on-site cold mix emulsion asphalt batching plant. Post excavation confirmatory

sampling was conducted to ensure that all soil with COC concentrations exceeding DDOU soil cleanup levels was removed.

Action Memorandum Addendum: The selected removal action for DDOU was modified. Changes to the selected removal action included: establishment of RALs to replace cleanup levels presented in the AM; and expansion of offsite disposal options to include RCRA Subtitle D facilities. These changes are documented in AM Addendum for Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal (AFCEE 2003) for the SARAP.

B.2. Removal Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. Investigations conducted at the DDOU demonstrate that surface soil contaminated with multiple PAHs, pesticides and inorganics may pose unacceptable risk to humans and ecological receptors. RAOs were developed based on these considerations, and were established to achieve the overall objective of protecting human health and the environment.

MMR-specific STCLs used for the DSRP (HAZWRAP 1996) were retained and used to develop cleanup level concentrations for identified COCs. In 2000, AFCEE with concurrence from EPA and MassDEP revised ecological risk-based STCLs for inorganic chemicals in a technical memorandum (HAZWRAP 2000). In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the STCL technical memorandum (AFCEE 2002).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs were documented in the AM Addendum finalized in 2003 (AFCEE 2003). Presented in Table B-1 are RALs that must be achieved to meet remedial response objectives for the DDOU.

Table B-1 COCs and Respective RALs for the DDOU		
COC	**Basis**	**RAL (ppm)**
Arsenic	Ecological	7.1
Chromium	Background	19
Lead	Ecological	99
Vanadium	Ecological	47
Zinc	Ecological	68
2-chlorophenol	Ecological	300
1,2,4-trichlorobenzene	Ecological	9,250
2,4-dinitrotoluene	Ecological	330
Pentachlorophenol	Ecological	800
Phenanthrene	Ecological	625
4,4'-DDD	Ecological	2.41
4,4'-DDE	Ecological	0.227
4,4'-DDT	Ecological	0.250
alpha-BHC	Ecological	0.203

B.3. Removal Action Implementation. AFCEE completed the removal action in 2001. Approximately 213 cubic yards of contaminated soil was excavated from DDOU. Because, pesticide-contaminated soil was a result of leaking drums containing product,

the contaminated soil was considered a listed RCRA hazardous waste (U060/U061) and therefore, required disposal at a RCRA Subtitle C TSDF. The contaminated soil was excavated, loaded directly into trucks, and transported to Ross Incineration Services located in Grafton, Ohio.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Final Priority 2 and 3 Study Areas and DDOU Removal Action Report: Completed in April 2004 (AFCEE 2004).
- AOC DDOU was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the AM modified by the AM Addendum.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

<u>Changes in Standards and To-Be Considered</u>: Cleanup standards for the DDOU removal action were ecological risk-based. No cleanup standards have been promulgated based on ecological risk.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics: Ecological risk-based RALs for several inorganic constituents were calculated using toxicity information available in 2000 which are presented in a technical memorandum (AFCEE 2000). The DDOU removal action completed in 2001 was based partly on these ecological risk-based RALs. No changes in toxicity and/or contaminant characteristics triggered the need to reevaluate ecological risk-based RALs.

Changes in Risk Assessment Methods: Not applicable, no risk evaluation was performed for the DDOU. The removal action was based on a comparison of delineation sampling results with DSRP ecological risk-based STCLs presented in the AM and calculated risk-based RALS (inorganics only) presented in the technical memorandum (AFCEE 2000) and established in the AM Addendum (AFCEE 2003).

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USGS). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USGS land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The removal action selected for the DDOU (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing COCs above ecological risk-based RALs have been removed. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation*, Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2004 (November). *Final Removal Action Report Priority 2 and 3 Study Areas and Drum Disposal Operable Unit.* Prepared for AFCEE/MMR Installation Restoration Program.

_____. 2003 (February). *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program.

_____. 2002 (September). *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels for Inorganics*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program.

_____. 2000 (December). *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1999 (June). *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal.* Prepared for AFCEE/MMR Installation Restoration Program by HAZWRAP, Oakridge, Tennessee.

_____. 1998 (October). *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis,* Prepared for AFCEE/MMR Installation Restoration Program, Massachusetts Military Reservation by HAZWRAP, Portland, Maine.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

HAZWRAP. 1996 (January). *Soil Target Cleanup Levels, DSRP*. Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

3.6.20 Fuel Spill No. 1 (FS-1) Source

A. Background

A.1. Site Description. Study Area FS-1 source area occupies approximately 2 acres along taxiway E, which is located in the southeastern portion of MMR (Figure 1-1). AOC FS-1 source area is located within the flightline area and includes the Eastern Aircraft Turnaround (EAT) and the Western Aircraft Turnaround (WAT).

A.2. Initial Response. Not applicable.

A.3. Basis for Taking Action. Environmental restoration at FS-1 Source followed the CERCLA RI process. Provided below is a summary of investigations performed at FS-1 Source.

Preliminary Assessment: In 1983, an IRP Phase I records search to identify sites at MMR indicated the need for further investigation at AOC FS-1. Records searches indicated that the EC-121 Super Constellation aircraft were parked at the EAT and WAT and fuel valves were tested. The valves were opened and the fuel allowed to drain. Initially, records suggest the fuel was hosed off the concrete. The exact quantity of fuels released onto the concrete is unknown.

Phase II Confirmation/Quantification, Stage 1 Study: Initial investigations were performed during the 1985 Phase II Stage 1 study, *Phase II-Confirmation/Quantification, Stage 1* (Weston 1985). The initial investigations included eight test pits and one water table monitoring well. Fuel-related contamination was not detected in soil.

Site Investigation: The SI program at AOC FS-1 included a soil gas survey and the installation of one soil boring (TB-3) and three monitoring wells (MW-1, MW-2, and MW-4). 30 soil gas sampling points were located where fuel valve testing was suspected to have been conducted. Samples were analyzed for chlorinated hydrocarbons and fuel-related hydrocarbons. Overall, soil gas results suggested minimal near-surface residual

contamination from previous fuel valve testing activities. Deep subsurface soil samples (> 15 ft bgs) were collected and analyzed for SVOCs, pesticides/PCBs, and inorganics (E.C. Jordan Co. 1989, 1990).

Remedial Investigation: In 1999, a RI was performed in which FS-1 was differentiated into two operable units: FS-1A Source Area and FS-1B downgradient groundwater. Operable unit FS-1B and FS-1A Source Area monitoring wells are discussed in the groundwater section of this document (Section 4.4.9). Twelve subsurface soil samples from six of the monitoring well borings were collected. Samples were collected from depths greater than 15 ft bgs. Samples were analyzed for select VOCs, SVOCs, pesticides/PCBs, and metals. Metals were detected but were within background (AFCEE 1999).

Supplemental Surface Soil Sampling: Supplemental surface soil sampling was conducted at the FS-1 source area in September of 1995. The purpose of this sampling was to provide surface soil data for the human health and ERAs. Five surface soil samples were collected from the area surrounding the WAT and were analyzed for VOCs, SVOCs, pesticides/PCBs, inorganics, and TPH. VOCs and TPH were not detected. Low levels of SVOCS and pesticides were detected. Inorganic compounds were detected but were in the range for background concentrations.

A human health and ERA was performed for surface soil. Because the FS-1 Source Area is located within the flightline, the utility worker exposure scenario was used to determine human health risk. Pesticides were identified as COPCs; however calculated risk based on worker exposure scenario was below the EPA target risk range and the MassDEP target value. Ecological risk results did not warrant action to be protective of ecological receptors.

B. No Further Action Decision

This section presents a summary of the no further action decision for FS-1 Source Area (soil only).

Record of Decision: In 2000, a ROD was completed which presented the selected remedial actions for AOC FS-1 (AFCEE 2000). The ROD included both source area and groundwater associated with FS-1. The selected remedy for the source area soil is no further action is based on the results of the HHRA and ERA.

For the downgradient groundwater contamination, the selected remedy is groundwater treatment. Monitoring was selected for the source area groundwater. The selected remedy for FS-1 groundwater including "source area" groundwater monitoring wells is discussed in the groundwater section of this document.

C. Progress Since the Last Five-Year Review

No activities were conducted for FS-1 Source (soil) since the last review.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the no action decision for FS-1 Source (soil) has been completed as intended by the ROD.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

Changes in Standards and To-Be Considered: Not applicable.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action for FS-1 Source (soil).

Changes in Toxicity and Other Contaminant Characteristics: There are no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: There have no changes in risk assessment methods.

Review of RAOs: Not applicable, no further action is required for FS-1 Source (soil).

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the no further action for FS-1 Source (soil) based on current land use. This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USGS land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for the FS-1 Source (soil) currently protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

AFCEE. 2000 (April). *Record of Decision Area of Contamination FS-1.* Prepared by HAZWRAP, Oak Ridge, TN. Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1999 (May). *Final FS-1 Remedial Investigation Report, Remedial Investigation Report Area of Concern*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1990 (February). *Inspection Report Task 2-3B, Field Investigation Work Conducted Spring-Summer 1988.* Prepared by E.C. Jordan, Co. Portland Maine. Prepared for HAZWRAP, Oakridge, Tennessee.

_____. 1989 (March). *Site Inspection Report Task 2-3A, Field Investigation Work Conducted Fall 1987.* Prepared by E.C. Jordan, Co. Portland Maine. Prepared for HAZWRAP, Oakridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

Weston. 1985. *Phase II-Confirmation/Quantification, Stage 1.* Prepared by Weston, R.F., Inc. Prepared for Installation Restoration Program, Otis ANG Base, MA.

3.6.21 Fuel Spill No. 2 USCG (FS-2 USCG) Source

A. Background

A.1. Site Description. This study area is a lightly wooded, half-acre parcel of land located adjacent to Turpentine Road at MMR (Figure 1-1). A hot-mix plant was operated at this site between 1941-1943. As part of the plant's operations, trucks used for transporting bituminous asphalt were washed with kerosene or diesel fuel to remove excess asphalt. The fuel and resultant waste were reportedly spilled on the ground.

A.2. Initial Response. None.

A.3. Basis for Taking Action. Environmental restoration at FS-2 (USCG) followed the CERCLA SI process. Provided below is a summary of investigations performed at Study Area FS-2 (USCG).

Preliminary Assessment: A PA conducted in 1986 (E.C. Jordan Co. 1986) identified Study Area FS-2 (USCG) as a potential area of release of hazardous substances.

Site Investigation: Study Area FS-2 (USCG) was investigated beginning in 1990 (ABB-ES 1993) and in 1995. Soil sampling was conducted during excavation of test pits and drilling of a monitoring well for the purpose of geologic logging and chemical analysis. PAHs and petroleum hydrocarbons were detected in surface and subsurface soil samples. No constituents exceeded MCLs in groundwater samples.

Analytical data was used to perform a PRE for surface soil, subsurface soil, and groundwater. There were exceedances of Tier I HECs for some PAHs and arsenic in the surface soil PRE; therefore, a Tier II PRE for surface soil using a recreational older-child exposure scenario was completed. No contaminants were identified as exceeding Tier II HECs based on a recreational older-child exposure scenario. For subsurface soil, a Tier I PRE based on occupational (i.e., worker) use was performed. Benzo (a) pyrene exceeded the Tier I HEC but not the Tier II HEC. For groundwater, manganese exceeded Tier I

HEC based on a residential exposure scenario; however it was not identified as a groundwater COC.

An ecological PRE was also completed for FS-2 (USCG). Tiers I and II of the ecological PRE showed that maximum concentrations of several SVOCs and inorganic analytes exceeded the lowest HECs. However, no additional characterization or action was recommended to address ecological risk.

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area FS-2 (USCG).

Decision Document: A Decision Document documenting the no further action decision was finalized in December 1999 (AFCEE 1999). The no further action was based on multi-media sampling conducted as part of the SI and on the risk analysis for soil and groundwater based on current and anticipated land and groundwater use scenarios.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Study Area FS-2 (USCG) was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action or no further action decision functioning as intended by the decision documents?

To be determined. New MassDEP soil standards were promulgated since the last five-year review. Site characterization data needs to be re-evaluated to determine if the no further action remains protective, and whether any further action is required.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action or no further action selection still valid?

<u>Changes in Standards and To-Be Considered</u>: PAHs were detected in soil samples collected at FS-2 (USCG). There have been changes in chemical-specific ARARs. MassDEP has re-evaluated S-1/GW-1 and S-2/GW-1 standards since the last five-year review. The new MassDEP standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. Concentrations of PAHs detected in soil need to be compared to new MassDEP soil standards to determine if the no further action decision remains protective.

<u>Changes in Exposure Pathways</u>: FS-2(USCG) is a site located outside the flightline but within the installation boundaries. There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action decision for Study Area FS-2 (USCG).

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: PAHs were detected in surface and subsurface soils. MassDEP has promulgated new soil standards that take into consideration updated toxicity information and other contaminant characteristics. Refer to the discussion above regarding new MassDEP soil standards.

<u>Changes in Risk Assessment Methods</u>: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the no further action decision.

<u>Review of RAOs</u>: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action or no further action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

(1) As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

(2) The new MassDEP soil standards for PAHs could potentially affect the protectiveness of the no further action decision.

F. Recommendations and Follow-Up Actions

(1) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable

institutional controls preventing uses for which the site may still pose an unacceptable risk.

(2) New MassDEP soil standards for certain PAHs have been promulgated. AFCEE shall determine if the new standard is applicable. Site characterization, delineation data, and confirmation data needs to re-evaluated to determine protectiveness of the removal action, and whether any further action is required.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation.* Massachusetts Military Reservation. Prepared for HAZWRAP. Portland, Maine.

AFCEE. 1999 (December). *Decision Document Study Area FS-2 (USCG)*. Prepared by Harding Lawson Associates for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.22 Fuel Spill No. 3 (FS-3) Source

A. Background

A.1. Site Description. Study Area FS-3 known as the Johns Pond Road Fuel Dump Site is located on Back Road just south of the MMR boundary, upgradient of the Briarwood residential area and Johns Pond (Figure 1-1). It consists of a 1,500-foot section of Back Road and the area approximately 50 feet off either side of the road. Between 1955 and 1962, fuel or fuel-contaminated water was drained onto the study area by refueler tanks to facilitate maintenance.

A.2. Basis for Taking Action. Environmental restoration at FS-3 followed the CERCLA SI process. Provided below is a summary of investigations performed at Study Area FS-3.

Preliminary Assessment: A PA conducted in 1986 (E.C. Jordan Co. 1986) identified Study Area FS-3 as a potential area of release of hazardous substances. The PA identified components of JP-4 jet fuel and AVGAS as potential contaminants.

Site Inspection: A SI was conducted at FS-3 in 1990. The SI included surface soil, subsurface soil sampling, and groundwater sampling. Samples were analyzed for TCL SVOCs and TAL inorganics. Surface soil samples were also analyzed for pesticides and PCBs. VOC analysis was performed based on PID readings. Only three VOC soil samples were submitted for off-site analysis based on field screening using PID.

SVOCs, pesticides, and PCBs were not detected in any samples. Seventeen of 20 TAL inorganic compounds were detected in concentrations greater than the maximum subsurface soil background concentrations established for the MMR (E.C. Jordan Co. 1990).

Groundwater samples were collected from three monitoring wells. Samples were analyzed for TCL VOCs, SVOCs, and TAL inorganic analytes. Groundwater at the site

contained no fuel-related organic compounds or inorganics above MMR background concentrations. TCE was detected in one sample, however it was suspected to be from another source area.

Data from the SI was used to perform a human health PRE for the FS-3 study area. For surface soil, a Tier I and a Tier II PRE based on residential use was performed. Results of the Tier I human health PRE for future residential use (surface soil) showed HEC exceedances for arsenic, beryllium, and iron; however, there were no exceedances for Tier II human health HEC values. Results of the Tier I human health PRE for future worker use (subsurface soil) showed a HEC exceedance for iron; however, there was no exceedance for the Tier II human health HEC value. For groundwater, maximum concentrations of analytes were compared to PRE Tier I HECs (residential exposure scenario) and to available MCLs. Several analytes exceeded PRE Tier I HECs; however, concentrations were consistent with the range of MMR-specific background.

An ecological PRE was also performed for Study Area FS-3. The ecological PRE showed HEC exceedances for chromium and cyanide in surface soil. Calculation of HI values for site ecological receptors showed the HI exceeded 10 for one of three target receptors; the HI for the cardinal was 20. Essentially 100% of the HI was attributed to cyanide, which was detected in only one of the six surface soil samples.

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area FS-3.

<u>Decision Document</u>: A Decision Document documenting the no further action decision was finalized in May 1997 (AFCEE 1997). The no further action was based on multi-media sampling conducted as part of the SI. The no further action decision was also based on the risk analysis for soil and groundwater based on current and anticipated land and groundwater use scenarios.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Study Area FS-3 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action functioning as intended by the decision documents?

Not applicable, no remedial/removal action was conducted at Study Area FS-3.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action selection still valid?

Changes in Standards and To-Be Considered: Not applicable, no remedial/removal action was conducted at Study Area FS-3.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action decision for Study Area FS-3.

Changes in Toxicity and Other Contaminant Characteristics: There were no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the no further action decision.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.2 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either

(1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1992 (October). *Comprehensive Plan for Installation Restoration Program at Massachusetts Military Reservation, Cape Cod, Massachusetts*. Prepared for HAZWRAP, Portland, Maine.

AFCEE. 1997 (May). *Final Decision Document Study Area FS-3 Johns Pond Road Fuel Dump Site*. Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1990 (February). *Final Site Inspection Report, Field Investigation Work Conducted Spring-Summer 1988, Task 2-3B*. Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

_____. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6*. Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory, Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

HAZWRAP. 1996 (January). *Soil Target Cleanup Levels, DSRP.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for AFCEE/MMR.

3.6.23 Fuel Spill No. 4 (FS-4) Source

A. Background

A.1. Site Description. AOC FS-4 consists of the area surrounding the former Building 178, a fuel pump house. It is approximately 0.75 acres, and is located on the MMR within the restricted zone of the flightline (Figure 1-1).

AOC FS-4 was evaluated as part of the Task 6 Records Search. According to the records search, five USTs were installed at the pump house in 1956. Four USTs were used to store AVGAS, one UST was used as a defueling tank, and the other UST was used as a collection tank. From the late 1950 until the early 1970s, AVGAS was pumped to the pump house and the USTs from the PFSA. During this period the pump house had the capability of fueling and defueling aircraft through a network of underground fuel distribution lines in the aircraft apron. The fuel line from the PFSA was abandoned after EC-121 aircraft operations ceased at MMR in the early 1970s (E.C. Jordan Co. 1986).

A.2. Initial Response.

Fuel System Upgrade Program Activities: In 1994, as part of the FSUP, the five USTs at pump house 178 were removed along with a 25,000 gallon defueling UST located east of the former pump house. The pump house was demolished to gain access to the underlying USTs. During the removal, residual fuel contamination consisting of PAHs was identified beneath the former collection and defueling USTs, at 10 and 22 ft bgs, respectively. Qualitative PID headspace results obtained during the UST removals were the basis for this study area being included in the Priority 2 and 3 Study Areas and DDOU EE/CA (AFCEE 1998).

A.3. Basis for Taking Action. Environmental restoration at FS-4 followed the CERCLA non-time critical removal action process. Provided below is a summary of investigations performed at AOC FS-4.

Site Investigation: An SI was completed in October 1993 to determine the nature and extent of contamination at FS-4 (ABB-ES 1993). The exploration program was conducted in two phases, the investigation phase and the confirmatory phase. Exploration locations were selected based on the findings of the PA and observations of study area conditions made during the SI. The investigation phase consisted of the completion of two monitoring wells, one soil boring and 30 soil gas samples. The confirmation phase consisted of the installation of two monitoring wells and one soil boring; all abandoned in-place and filled with grout. The SI report recommended that no further action be conducted at this study area depending on results of the FSUP activities.

As part of the SI, a PRE was completed for surface and subsurface soil at AOC FS-4 including human-health and ecological exposure scenarios. The utility worker exposure scenario was chosen because the site was located inside the flightline. TPHs were identified as COCs.

Supplemental Site Investigation: In 1995, the two monitoring wells installed at study area FS-4 during Phase I of the SI were sampled for EDB analysis. Results indicated that EDB was not present in groundwater at concentrations above the sample quantitation limit (ABB-ES 1995).

Engineering Evaluation/Cost Analysis: AOC FS-4 was included as part of the Priority 2 and 3 Study Areas and DDOU EE/CA completed in October 1998 (AFCEE 1998). The EE/CA provided detailed analysis of three alternatives.

B. Removal Actions

This section presents the regulatory actions, RAOs, a description of the selected removal action, and a summary of the removal action implementation at AOC FS-4.

B.1. Regulatory Actions. Described below are the controlling documents that present the selected removal action and post-EE/CA documents that identified changes to the selected removal action.

Action Memorandum: An AM for the Priority 2 and 3 Study Areas and DDOU Source Removal (AFCEE 1999) documented the decision to perform removal actions at several Priority 2 and 3 study areas including FS-4. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 2 which included in-situ treatment for study area FS-4 as warranted. The AM called for additional investigation activities at FS-4 to focus on subsurface soil sampling and laboratory analysis to evaluate the amount and distribution of residual fuel contamination beneath the former collection and defueling USTs that may potentially act as a source of groundwater contamination. Implementation of the in-situ treatment system would be based upon results of this additional sampling.

Action Memorandum Addendum: AM Addendum for Priority 2 and 3 Study Areas and DDOU Source Removal (AFCEE 2003) was prepared to document changes to the selected remedial action for several sites encompassed by the AM. The selected remedial action for AOC FS-4 was changed with the establishment of new RALs for aliphatic and aromatic hydrocarbons.

Source Areas Remedial Design: In August 1999, soil sampling was completed at the AOC FS-4 source area as required by the AM for the Priority 2 and 3 Study Areas and DDOU Source Removal. Sampling was performed to evaluate the lateral and vertical extent of soil contamination to address the need for a possible removal action.

A total of 30 soil samples were collected and screened by headspace analysis. Six of these samples were selected for off-site analysis. The analysis included sampling for MassDEP S-1/GW-1 standards for petroleum hydrocarbons including VPHs and EPHs. The analytical results reported all samples to be below laboratory detection limits for

EPH/VPH, benzene, toluene, ethyl-benzene and xylenes (total). In accordance with the Source Areas Remedial Design, "No further action" is planned for this site and a Remedial Design Fact Sheet will be prepared to document this decision (AFCEE 2000a).

B.2. Removal Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet removal response objectives. The RALs are the site-specific quantitative cleanup levels that will meet RAOs. Total petroleum compounds which were identified in the AM as COCs were divided into aromatic and aliphatic classes of compounds (EPH/VPH). The Remedial Design sampling conducted in 1999 at AOC FS-4 indicated that soil was not contaminated with petroleum compounds and did not pose an unacceptable risk to humans and ecological receptors.

Presented in Table B-1 are that EPH/VPH classes of compounds and respective cleanup levels that were used to determine if in-situ treatment, the contingency removal action, was necessary.

Table B-1
MassDEP S-1/GW-1 Standards for Petroleum Hydrocarbons

Type of Petroleum Hydrocarbons	Basis	RAL (mg/kg)
Aliphatic Hydrocarbons		
C_5 through C_8 Aliphatic Hydrocarbons	Human Health	100
C_9 through C_{12} Aliphatic Hydrocarbons	Human Health	1,000
C_9 through C_{18} Aliphatic Hydrocarbons	Human Health	1,000
C_{19} through C_{36} Aliphatic Hydrocarbons	Human Health	2,500
Aromatic Hydrocarbons		
C_9 through C_{10} Aromatic Hydrocarbons	Human Health	100
C_{11} through C_{22} Aromatic Hydrocarbons	Human Health	200

B.3. Removal Action Description. The selected removal action documented in the AM (AFCEE 1999) consisted of in-situ treatment for AOC FS-4 soil based upon results of remedial design sampling. The selected removal action for FS-4 was modified by the AM Addendum. The change to the selected removal action was the establishment of RALs to replace cleanup levels presented in the AM. The change was documented in the AM Addendum for Priority 2 and 3 Study Areas and DDOU Source Removal (AFCEE 2003) for the SARAP.

B.4 Removal Action Implementation. Concentrations of EPH/VPH were all below RALs in Remedial Design samples collected in 1999. Documentation of no action at FS-4 will be provided in a future remedial design fact sheet (AFCEE 2000a).

C. Progress Since the Last Five-Year Review

- AOC FS-4 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

Yes, however in-situ treatment, the contingency removal action alternative, was not required based on the Remedial Design sampling conducted in 1999.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

Changes in Standards and To-Be Considered: TPHs which were the COCs identified in the AM was divided into aromatic and aliphatic classes of petroleum compounds (i.e., EPH/VPH). MassDEP S-1/GW-1 standards were used for cleanup standards. The change was documented in the AM Addendum (AFCEE 2003). MassDEP has reevaluated S-1/GW-1 standards since the last five-year review. The new S-1/GW-1 standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. The MassDEP S-1/GW-1 standard for C_{19} through C_{36} aliphatic hydrocarbons has increased from 2,500 mg/kg to 3,000 mg/kg. The MassDEP S-1/GW-1 standard for C_{11} through C_{22} aromatic hydrocarbons has increased from 200 mg/kg to 1,000 mg/kg. The new MassDEP S-1/GW-1 standards do not change the protectiveness of the decision of no further action based on the Remedial Design sampling conducted in 1999.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the decision of no further action based on the Remedial Design sampling conducted in 1999.

Changes in Toxicity and Other Contaminant Characteristics: MassDEP has re-evaluated S-1/GW-1 standards for EPH/VPH since the last five-year review. The MassDEP S-1/GW-1 standards are based on unrestricted use and take into consideration dermal exposure, ingestion exposure, and impact to groundwater.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the no further action decision based on the results of Remedial Design conducted in 1999.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

Remedial Design sampling results performed in 1999 indicated that no further action for this site currently protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this subsection need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1995. *Supplemental Sampling Report for Priority 2 and 3 Study Areas Sites*; Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

_____. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation*, Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2003 (February). *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program.

_____. 2000a (September). *Massachusetts Military Reservation, Cape Cod, Massachusetts, Source Areas Remedial Design, Volume 2 – Biosparging/Soil Vapor Extraction – Final Design for: FTA-2/LF-2, CS-10/FS-24, PFSA/FS-10/FS-11, and FS-4*. Prepared by T N & Associates, Inc. for AFCEE/MMR Installation Restoration Program.

_____. 2000b (December). *Final Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics.* Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program.

_____. 1999 (June). *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal*. Prepared by Harding Lawson Associates (HLA) for AFCEE/MMR Installation Restoration Program.

_____. 1998 (October). *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis.* Prepared by HLA for AFCEE/MMR Installation Restoration Program.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory, Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.24 Fuel Spill No. 7 (FS-7) Source

A. Background

A.1. Site Description. AOC FS-7 known as the CPT-115 site , is approximately one acre, and is located in the vicinity of the former Building 1820 at the northwest rotary between West Outer Road and West Inner Road on the MMR (Figure 1-1).

A.2. Initial Response. A UST, CPT-115, was removed in June 1985. In 1996, Building 1820 at the study area was demolished and the asphalt driveway that surrounded the building was removed.

A.3. Basis for Taking Action. Environmental restoration at AOC FS-7 followed the CERCLA non-time critical removal action process. Provided below is a summary of investigations performed at AOC FS-7.

Preliminary Assessment: A PA conducted in 1986 as part of the MMR Phase I IRP studies (E.C. Jordan Co. 1986) identified Study Area FS-14 as a potential area of release of hazardous substances. According to the records search, CPT-115, a 500-gallon UST installed in 1970 at the study area and used to store No. 2 fuel oil, may have leaked up to 11,000 gallons of fuel.

Priority 2 & 3 Study Area Site Investigation: A SI was completed in October 1993 to determine the nature and extent of contamination suspected at FS-7 (ABB-ES 1993). The primary contaminant was No. 2 fuel oil that leaked from CPT 115, prior to its excavation in 1985. The exploration program was conducted in three phases. Exploration locations were selected based on the findings of the PA and observations of study area conditions made during the SI. Phase 1 consisted of investigating the study area utilizing ground-penetrating radar, a magnetometer, and a metal detector. Ten soil gas samples were taken and one monitoring well was installed. Phase 2 consisted of the collection of two surface soil samples and Phase 3 consisted of the installation of one monitoring well. Metals and

petroleum hydrocarbons were detected in surface soil samples and SVOC tentatively identified compounds were detected in subsurface soil samples. Groundwater has low levels of petroleum compound contamination suspected to be from upgradient from AOC FS-7.

Data from the SI was used to perform a human health PRE for the AOC FS-7. For surface soil, a Tier I and Tier II PRE based on residential use was performed. A subsurface soil risk evaluation was not performed. No COPCs were in soil above Tier II HECs, therefore no action was recommended to address surface soil. For groundwater, COPCs were not detected above Tier II HECs, therefore, no action was recommended to address groundwater.

An ecological PRE was also performed for AOC FS-7. The results of the ecological PRE indicated that there was potential for adverse effects on ecological receptors due to metals detected in soil. However, because the metal concentrations were indicative of background, no action was recommended for protection of ecological receptors.

Even though no action was recommended based on risk analysis, the SI recommended the collection of subsurface soil samples from below the former UST.

<u>Supplemental Site Investigation</u>: An SSI was completed in 1995. The SSI consisted of the completion of one test pit, the collection of six surface soil samples, and the completion of two soil borings (Aneptek 1996). Each soil boring was completed as a monitoring well, and a round of groundwater samples was collected for off-site analysis. The data collected during the SSI was utilized to complete a second PRE for the study area.

Data collection during the SSI showed the presence of PAHs in surface soil above HECs at two locations. Based on the SSI PRE, the SSI recommended that a soil removal action be conducted to remove the PAH contamination.

Engineering Evaluation/Cost Analysis: AOC FS-7 was one of the sites in the Priority 2 and 3 Study Areas and DDOU EE/CA which were issued in October 1998 (AFCEE 1998).

The following alternatives received detailed analysis in the EE/CA:

- Alternative 1: On-base Thermal Desorption and Off-base Treatment and Disposal.
- Alternative 2: On-base Asphalt Batching and Off-base Treatment and Disposal.
- Alternative 3: Off-base Treatment and/or Disposal.

B. Removal Action

This section presents the regulatory actions, RAOs, a description of the selected removal action, and a summary of the removal action implementation at AOC FS-7.

B.1. Regulatory Actions. Described below are controlling documents that present the selected removal action and post-AM documents that identified changes to the selected removal action.

Action Memorandum: The Priority 2 and 3 Study Areas and DDOU Source Removal AM (AFCEE 1999) documented the decision to perform removal actions at several Priority 2 and 3 Study Areas including FS-7. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 2 which included excavating FS-7 soil and treating the excavated material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility.

Action Memorandum Addendum: Priority 2 and 3 Study Areas and DDOU Source Removal AM Addendum (AFCEE 2003) was prepared to document changes to selected removal actions for several sites in the SARAP including FS-7. Two changes were made to selected removal actions presented in the Priority 2 and 3 Study Areas EE/CA that affected AOC FS-7: (1) removal of the asphalt-batching component from the selected

removal action, and (2) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2. Removal Action Objectives. The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The remedial response objectives included the removal of surface soil south of Building 1820 in the vicinity of surface soil sampling location SS-6 to reduce the risk of human and ecological exposure to PAHs. MMR-specific STCLs used for the DSRP (HAZWRAP 1996) were retained and used to develop cleanup levels for identified COCs.

Table B-1
COCs and RALs for FS-7

Contaminant	Basis	RAL (mg/kg)
Benzo(a)anthracene	STCL outside Eco & Human (0-2 ft)	5*
Benzo(b) fluoranthene	STCL outside Eco & Human (0-2 ft)	5*
Benzo(k) fluoranthene	STCL outside Eco & Human (0-2 ft)	5*
Benzo(g,h,i)perylene	STCL outside Eco & Human (0-2 ft)	5*
Benzo(a)pyrene	STCL outside Eco & Human (0-2 ft)	5*
Chrysene	STCL outside Eco & Human (0-2 ft)	0.625
Dibenzo(a,h)anthracene	STCL outside Eco & Human (0-2 ft)	5*
Indeno(1,2,3-c,d)pyrene	STCL outside Eco & Human (0-2 ft)	5*
Phenanthrene	STCL outside Eco & Human (0-2 ft)	0.625

Note: The sum of seven carcinogenic PAHs must not exceed 5 mg/kg total.

B.3. Removal Action Implementation. AFCEE conducted removal activities in 2001 at AOC FS-7. Removal activities and results of confirmatory sampling were documented in the Priority 2 and 3 and DDOU Removal Action Report (AFCEE 2004). Approximately 18 cubic yards of contaminated soil was excavated from AOC FS-7 and combined with soil excavated from other SARAP sites with similar disposal requirements. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. FS-7 soil was disposed of at the Taunton Landfill in Massachusetts, in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MassDEP 1997).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- Final Priority 2 and 3 Study Areas and DDOU Removal Action Report: Completed in April 2004.
- AOC FS-7 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the removal action functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the removal action has been completed as intended by the AM modified by the AM Addendum.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

Changes in Standards and To-Be Considered: There have been changes in chemical-specific ARARs. MassDEP has re-evaluated S-1/GW-1 standards since the last five-year review. The new S-1/GW-1 standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. All of the COCs have chemical-specific MassDEP S-1/GW-1 standards. Seven of the nine PAHs have MassDEP S-1/GW-1 standards that are less stringent that the cleanup standards used for the removal action. However, benzo(a)pyrene and dibenz(a,h)anthracene have standards lower than the maximum allowable combined concentrations for the seven PAHs (Table B-1). The new MassDEP S-1/GW-1 standards for benzo(a)pyrene and dibenz(a,h)anthracene could potentially affect the protectiveness of the implemented removal action.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics: MassDEP S-1/GW-1 standards have changed for the COCs identified for AOC FS-7. Please refer to the section discussing changes in cleanup standards.

Changes in Risk Assessment Methods: MassDEP S-1/GW-1 standards have changed for the COCs identified for AOC FS-7. Please refer to the section discussing change in cleanup standards.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure

pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

(1) As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

(2) The new MassDEP S-1/GW-1 standards for benzo(a)pyrene and dibenz(a,h)anthracene could potentially affect the protectiveness of the removal action.

F. Recommendations and Follow-Up Actions

(1) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

(2) MassDEP S-1/GW-1 standards for benzo(a)pyrene and dibenz(a,h)anthracene are more stringent than those used for the removal action. AFCEE shall determine if the

new standard is applicable. Site characterization, delineation data, and confirmation data needs to re-evaluated to determine protectiveness of the removal action, and whether any further action is required.

G. Protectiveness Statement

The removal action selected for AOC FS-7 (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation*. Installation Restoration Program, Massachusetts Military Reservation, Otis ANG Base, MA. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2004 (April). *Final Removal Action Report Priority 2 and 3 Study Areas and Drum Disposal Operable Unit*. Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2003 (February). *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1999 (June). *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal*. Installation Restoration Program, Massachusetts Military Reservation. Prepared for AFCEE/MMR by HAZWRAP Oakridge, Tennessee.

_____. 1998 (October). *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis*. Installation Restoration Program, Massachusetts Military Reservation. Prepared for AFCEE/MMR by HAZWRAP, Portland, Maine.

Aneptak Corporation. 1996 (August). *Final Supplemental Site investigation and Site Inspection Report, Fuels Spill Sites FS-7 & FS-14 Massachusetts Military Reservation, Cape Cod, Massachusetts.* Prepared for ANG Readiness Center, Andrews Air Force Base, Maryland.

E.C. Jordan Co. 1986 (December). U.*S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6*. Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory, Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

HAZWRAP. 1996 (January). *Soil Target Cleanup Levels, DSRP.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for AFCEE/MMR.

MassDEP. 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection.

3.6.25 Fuel Spill No. 9 (FS-9) Source

A. Background

A.1. Site Description AOC FS-9 CPT-108 is located in the south central portion of the MMR (Figure 1-1). The site has been used for military vehicle maintenance. The site encompasses an area of approximately 7 acres and extends south a distance of approximately 720 feet from Building 1369 at the intersection of Beaman Road and West Truck Road to Building 1365. The paved portion of the site extends west a distance of approximately 120 feet, where it is bounded by undeveloped land. The developed portion of AOC FS-9 was a motor pool that remained in service from World War II until 1986. Presently, the site includes five buildings (Buildings 1365, 1366, 1367, 1368, 1369) and a closed leaching well.

The undeveloped portion of AOC FS-9 is primarily a grassy or pine covered area. Storm sewer headwalls discharge west of the paved portion of the site into a drainage ditch. The drainage ditch leads to a depression west of the site. This depression has been classified as a vernal pool.

Suspected sources of contamination at AOC FS-9 included USTs and activities associated with vehicle maintenance operations. The area is currently being used as a parking area for military vehicles.

A.2. Initial Responses.

<u>Fuel Upgrade Program</u>: The USTs along with the fuel island were removed as part of the Fuel Upgrade Program in 1994. The Fuel Systems Upgrade Report consisting of closure reports for CPT 106, 107, and 108 indicated that all contaminated soil was removed from the tank pits. (Metcalf & Eddy 1994).

Drainage Structure Removal Program: The waste disposal leaching wells and the catch basin were removed as part of the DSRP in 1996 (HAZWRAP 1996). Specifically, the catch basin and the leaching well adjacent to Building 1368 were removed and the leaching well adjacent to Building 1569 was abandoned in-place, following the removal of all wastes and decontamination of the structure using power-washing and steam-cleaning. Due to the location of the leaching well adjacent to Building 1369, this structure could not be removed because of structural concerns relative to the building. The structure adjacent to Building 1368 was removed along with 14 cubic yards of soil. Clean closure was achieved at the structure (AFCEE 1999b).

A.3. Basis for Taking Action. Several studies were conducted at AOC FS-9 to determine the nature and extent of contamination. COCs identified at AOC FS-9 included TPH, C_5-C_8 aliphatic hydrocarbons, chromium, lead, vanadium, and zinc. Provided below is a summary of investigation activities that described a characterization of the site.

Remedial Investigation: An RI was completed in 1998 (AFCEE 1998a). FS-9 was divided into five areas: (1) the motor pool fueling island and USTs, (2) the leaching wells and catch basis, (3) the waste disposal area, (4) the drainage ditch/swale area, (5) the pond/wet area, which was determined to be a vernal pool.

As part of the RI, an HHRA was performed. Soil, groundwater, and surface water were evaluated. A future residential exposure scenario was evaluated for surface soil. The utility worker exposure scenario is likely for subsurface soil; however it was not quantitatively evaluated. Groundwater, sediment, and surface water were evaluated based on exposure to adult residents. All calculated risks were within the EPA target risk range and target hazard indices with the exception of groundwater (using maximum concentrations). However the chemicals contributing to the majority of risk (i.e., arsenic and beryllium) were below Federal MCLs and background. Calculated risks slightly exceeded the MassDEP target risk of $1x10^{-5}$ for surface soil and groundwater under

residential exposure scenario. A major contributor to carcinogenic risk in surface soil was arsenic; however the maximum concentration is lower than the MassDEP S-1/GW-1 standard.

Lead was separately evaluated using an uptake/biokinetic model. Study area groundwater posed a slightly elevated cancer risk under a future residential exposure scenario, however this determination is based on lead results obtained from a well (AEHA-8) where the concentration of lead was suspected to be attributable to lead sorbed to particulate matter. In 1998, the well was resampled using a low flow method; the concentration resulted in a lead value of 1 J μg/L. In soil, lead was detected at high concentrations at two locations and was selected as a human health COC.

Several areas were identified during the RI with TPH concentrations exceeding the MMR STCL of 500 mg/kg. An MCP Method 3 risk characterization was performed in 1998. Location TP-11 was the only area for which action was required due to petroleum hydrocarbon contamination.

An ERA was also performed as part of the RI. The results of the EPA suggested that there was some risk to terrestrial receptors from exposure to surface soil and the drainage ditch. Ecological COCs identified were chromium, vanadium, and zinc.

Feasibility Study: A feasibility study was completed in October 1998 (AFCEE 1998b). Alternatives were developed to be protective of future resident for surface soil and utility worker for subsurface soil. The alternatives were also developed to be protective of ecological receptors and to mitigate impact of contaminants to groundwater. Alternatives that received detailed analysis in the feasibility study were:

1. No Action
2. Limited Action
3. Excavation/Asphalt Batching
4. Excavation/Asphalt Batching with Contingency Low Flow Vapor Extraction

5. Excavation/Offsite Treatment/Disposal
6. Excavation/Offsite Treatment/Disposal with Contingency Low Flow Vapor Extraction

B. Remedial Action

This section presents the regulatory actions, RAOs, remedy description, and a summary of the remedy implementation at AOC FS-9.

B.1.Regulatory Actions. Described below are controlling documents that present the selected remedy and post-ROD documents that identified changes to the selected remedy.

Record of Decision: The selected remedy (Alternative 6 in the feasibility study) consisted of excavation of contaminated surface soil at three source areas (i.e., former UST location [CPT107/CPT108], the fence line hot spot [SS1], and the TPH hot spot [TP-11]); on-site cold-mix asphalt batching of recyclable excavated soil; off-site disposal of non-recyclable excavated soil; and post excavation confirmatory sampling to ensure that all soil with COC concentrations exceeding FS-9 soil cleanup levels were removed, implementation and maintenance of access restrictions, and five-year reviews of remedy protectiveness at all three source areas. Furthermore, a contingency remedy to implement a SVE treatment system if confirmation sampling indicates that subsurface soil contamination is beyond the practical limits of excavation at the tank pit area. The ROD, finalized in June 1999, documented the selected remedy (AFCEE 1999a). The selected remedy was not changed as a result of public comments received as part of the Proposed Plan process.

Pre-Design Sampling and Analysis Report: Confirmatory sampling was conducted at tank former UST location (CPT107/CPT108) as part of the SVE design to address TPH contamination at the subsurface (TN&A, Inc. 2000). Results indicate that subsurface contamination did not exist; therefore no further action was required at the tank former UST location (CPT107/CPT108).

Explanation of Significant Differences: An ESD was prepared to document changes to the selected remedy for AOC FS-9 (AFCEE 2003). Three changes are made to the selected remedy presented in FS-9 ROD: (1) establishment of RALs for certain inorganic chemicals, and petroleum hydrocarbons and (2) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2. Remedial Action Objectives The RAOs are site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The remedial response objectives include: (1) reduce exposure of humans to TPH, C_5-C_8 aliphatic hydrocarbons, and lead at the former UST location (CPT107/CPT108), TPH Hot Spot (TP-11), and the fence-line soil hot spot (SS-1) and (2) reduce exposure of ecological receptors to chromium, vanadium, and zinc in the former UST location, and fence line soil hot spot.

STCLs used for the DSRP were retained and used to develop cleanup levels for identified contaminants of concern. In 2000, AFCEE with concurrence from EPA and MassDEP revised ecological risk-based STCLs for inorganic chemicals in a technical memorandum (AFCEE 2000).

In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the technical memorandum (AFCEE 2002a).

The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background. Development and establishment of RALs were documented in an ESD prepared in 2003 (AFCEE 2003). Furthermore, the ESD documents the establishment of MassDEP Method S-1/GW-1 EPH/VPH cleanup standards as RALs in instances where TPH were considered COCs. Presented in Table B-1 and Table B-2 are RALs that must be achieved to meet remedial response objectives for FS-9.

Table B-1 COCs and Respective RALs for FS-9		
COC	**Basis**	**RAL (mg/kg)**
Chromium	Ecological	19
Lead	Human	99 (0-2 ft bgs)
	Human	300 (>2 ft bgs)
Vanadium	Ecological	47
Zinc	Ecological	68

Table B-2 MassDEP S-1/GW-1 Standards for Petroleum Hydrocarbons	
Type of Petroleum Hydrocarbons	**ESD RAL (mg/kg)**
Aliphatic Hydrocarbons	
C_5 through C_8 Aliphatic Hydrocarbons	100
C_9 through C_{12} Aliphatic Hydrocarbons	1,000
C_9 through C_{18} Aliphatic Hydrocarbons	1,000
C_{19} through C_{36} Aliphatic Hydrocarbons	2,500
Aromatic Hydrocarbons	
C_9 through C_{10} Aromatic Hydrocarbons	100
C_{11} through C_{22} Aromatic Hydrocarbons	200

B.3. Remedy Implementation. AFCEE conducted a remedial action in 2001 at AOC FS-9. Remedial activities and results of confirmatory sampling are documented in a RAR (AFCEE 2002b). The actions were conducted at the drainage ditch located west of the paved area in an undeveloped portion of FS-9 and outside the fenced perimeter of the active area. Two areas were excavated. Sixty-six cubic yards of contaminated soil, was removed from the TPH hot spot (TP-11). Fifty-six cubic yards of contaminated soil were excavated from the fence-line hot spot (SS-1). Excavated soil was transported to an

onsite central bulking facility. Soil from AOC FS-9 was combined with soil from other sites. Consolidated soil from was disposed of at the Taunton Landfill, in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001*.

C. Progress Since the Last Five-Year Review

AOC FS-9 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, ARARs, risk assumptions, and the results of the site inspection indicate that the remedy has been completed as intended by the ROD modified by the ESD.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: There have been changes in chemical-specific ARARs. MassDEP has re-evaluated S-1/GW-1 standards since the last five-year review. The new S-1/GW-1 standards became effective on February 14, 2008 [see 310 CMR 40.0975(6)(a)]. The MassDEP S-1/GW-1 standard for C_{19} through C_{36} aliphatic hydrocarbons has increased from 2,500 mg/kg to 3,000 mg/kg. The MassDEP S-1/ GW-1 standard for C_{11} through C_{22} aromatic hydrocarbons has increased from 200 mg/kg

to 1,000 mg/kg. The new MassDEP S-1/GW-1 standards do not change the protectiveness of the implemented remedy.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: MassDEP has re-evaluated S-1/GW-1 standards for EPH/VPH since the last five-year review. The MassDEP S-1/GW-1 standards are based on unrestricted use and take into consideration dermal exposure, ingestion exposure, and impact to groundwater.

Changes in Risk Assessment Methods: The remedial action was completed in 2001. There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the implemented remedy.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

(1) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

2) MassDEP S-1/GW-1 standards for EPH/VPH have changed. AFCEE shall determine if the new standard is applicable.

G. Protectiveness Statement

The remedy selected for the AOC FS-9 (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing COCs above RALs have been removed. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness. There have been changes in the MassDEP S-1/GW-1 standards for EPH/VPH; however the remedy remains protective.

H. References

AFCEE. 2003 (January). *Explanation of Significant Differences Areas of Contamination CS-10 (A, B & C); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; and SD-3/FTA-3/CY-4*. Prepared by Engineering Strategies Corporation and Portage Environmental for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2002a (September). *Addendum to Technical Memorandum Revised Ecological Soil Target Cleanup Levels For Inorganics*. Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2002b (September). *Final Remedial Action Report Area of Contamination FS-9.* Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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_____. 1999a (June). *Record of Decision Area of Contamination FS-9*. Prepared by Hazardous Waste Remedial Actions Program for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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_____. 1998b (October). *Feasibility Study Area of Contamination FS-9*, Prepared by Hazardous Waste Remedial Actions Program for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

Metcalf & Eddy. 1994. *Fuel Systems Upgrade Report (Closure Reports CPT 106, CPT 107, CPT 108)*. Installation Restoration Program, Massachusetts Military Reservation, Otis ANG Base, MA.

TN & Associates, Inc. 2000 (August). *Pre-Design Sampling &Analysis Report For: Confirmatory Sampling at CS-10/FS-24; Additional Soil Sampling at CS-10/FS-24 BLDGS 4602 &4606; Data and Equipment Evaluation for SVE/Biosparging Design; Wetlands Determination and Delineation Studies at CS-10/FS-24 and FS-18; Pre-Excavation Study and Soil Sampling at SD-4; Geophysical Investigation of the DDOU; Confirmatory Sampling at SD-5/FS-5, and Confirmatory Soil Sampling at FS-9.* Installation Restoration Program, Massachusetts Military Reservation, Otis ANG Base, MA.

3.6.26 Fuel Spill No. 12 (FS-12) Source

A. Background

A.1. Site Description. AOC FS-12 Source is the location of a leak from an abandoned fuel pipeline along the base border in the town of Sandwich. The leak occurred near the intersection of Greenway Road and an unpaved road providing access to artillery range "L". The pipeline carried both jet fuel and AVGAS during its use from 1965 to 1973.

A.2. Initial Response. The damaged portion of the underground fuel pipeline was removed and replaced in 1972.

A.3. Basis for Taking Action.

Remedial Investigation: The RI for AOC FS-12 Source included soil and groundwater sampling. Surface soil samples were not collected because PID measurements were negligible. Nineteen subsurface soil samples and 52 groundwater samples were collected as part of the RI and analyzed for VOCs, SVOCs, metals, pesticides/PCBS, and EDB. The vertical extent of subsurface soil petroleum contamination was estimated to be a 10 to 20-foot layer above the water table (ASI 1995).

The RI report for AOC FS-12 Source included a human-health PRA. Subsurface soil was evaluated based on an occupational (worker) exposure scenario and FS-12 "source area" groundwater was evaluated based on a residential exposure scenario. For subsurface soil, calculated risk (for carcinogens) was within the EPA target risk range. The calculated hazard index for (noncarcinogens) was less than 1.0. For groundwater, (EDB) and several inorganics were identified as COCs. Since soil contamination is 6 ft bgs or greater, there is no exposure pathway for ecological receptors, therefore an ERA was not performed.

B. Remedial/Removal Actions

This section presents regulatory actions, a description of the selected removal action, and a summary of the removal action implementation at AOC FS-12 Source.

B.1. Regulatory Actions.

Action Memorandum: In November 1996, the *Final Action Memorandum AOC FS-12 Source Removal* was finalized. The AM documents the decision by AFCEE to conduct a time critical removal action at AOC FS-12 Source (ASI 1996). The selected removal action utilized an air sparging(AS)/SVE system to remove petroleum-derived hydrocarbons from subsurface soil.

B.2. Removal Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. Based on calculations from the risk assessment, the risk values calculated for current/future exposure to groundwater indicate carcinogenic risk for human exposure to groundwater, it was concluded that subsurface soil required immediate attention for cleanup. The RAO for AOC FS-12 Source included:

- Removing benzene and EDB concentrations that would contribute to groundwater concentrations greater than federal/state MCLs.

B.3. Removal Implementation. The AS/SVE system operated between October 23, 1995 and February 25, 1998. Vapor-phase benzene, toluene, ethylbenzene, xylene (BTEX) contaminants were destroyed thermally by passing the soil vapor through a catalytic oxidation unit. Since EDB is not readily removed by thermal oxidization, and to prevent the airborne release of EDB, gases from the catalytic oxidation unit were then passes through a carbon adsorption unit (AFCEE 2000).

In a March 1, 1999 letter from EPA to AFCEE, regarding AOC FS-12 Source closure; the EPA and MassDEP agreed that elevated contaminant levels in the zone of saturation would not be effectively addressed by continued operation of the AS/SVE system. As a

condition to shutdown of the AS/SVE system at the AOC FS-12 Source, AFCEE agreed to monitor selected groundwater-monitoring wells. Initially eight FS-12 Source wells were added to the FS-12 groundwater operable unit monitoring program commencing with the April/May 1999 sampling event. Currently five AOC FS-12 Source wells are being monitored.

C. Progress Since the Last Five-Year Review

The following documents present activities that have been conducted since the last review:

- Final FS-12 2002 Annual System Performance and Ecological Impact Monitoring (SPEIM) Report (AFCEE 2003);
- Final FS-12 2003 Annual SPEIM Report (AFCEE 2004);
- FS-12 2005 Summary Letter Report (AFCEE 2006);
- FS-12 2006 Summary Letter Report (AFCEE 2007);
- FS-12 2007 Summary Letter Report (AFCEE 2008).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The removal action completed in 2000 has removed petroleum-related compounds and a monitoring well network was implemented to monitor VOCs and EDB. Concentrations have generally been decreasing; therefore the removal action (i.e., operation of the AS/SVE system) is functioning as intended by the AM.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been no changes in standards and to-be considered.

Changes in Exposure Pathways: There have been no changes in the physical conditions and exposure pathways that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in the toxicity or contaminant characteristics.

Changes in Risk Assessment Methods: There were no changes in HHRA methodology.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the removal action for FS-12 Source (soil) based on current land use. This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.2.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

(1) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

(2) Continue to monitor the AOC FS-12 Source wells.

G. Protectiveness Statement

The removal action conducted for the FS-12 (source control using AS/SVE) has mitigated impact to groundwater based on groundwater monitoring results. The no further action decision for this site currently protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

Advanced Sciences, Inc. (ASI). 1996 (November). *Final Action Memorandum, AOC FS-12 Source Removal; Installation Restoration Program; Massachusetts Military Reservation*. Prepared for HAZWRAP; Oak Ridge, Tennessee.

______. 1995 (January). *Final Remedial Investigation Report, FS-12 Study Area.* Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Oak Ridge, Tennessee.

AFCEE. 2008 (March). *FS-12 2007 Summary Letter Report*. Prepared by CH2M HILL for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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______. 2000 (March). *FS-12 Source Area Removal Action Summary Report*. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.27 Fuel Spill No. 13 (FS-13) Source

A. Background

A.1. Site Description. AOC FS-13 Soil as the FS-13 Underground Fuel Line Cantonment occupies approximately 4,000 square feet and is located in the Cantonment Area, east of the Connery Avenue Rotary and south of the water tower (Figure 1-1) on MMR.

A.2. Initial Response. The fuel spill was discovered in 1972 during a routine walk-over inspection of an underground fuel supply pipeline. Subsequently, the area was excavated and a porous section of pipe was replaced. The fuel supply pipeline was used for the transport of both AVGAS and JP-4 fuel and is the same pipeline that was the source of the fuel spill designated as AOC FS-12.

A.3. Basis for Taking Action. AOC FS-13 Soil followed the CERCLA SI process. Described below is a summary of site characterization activities for AOC FS-13 Soil.

Records Search: According to the Phase I Records Search, the fuel leak consisted of approximately 2,000 gallons of JP-4 jet fuel (E.C. Jordan Co. 1986). The area investigated was determined from recollections of personnel who discovered the spill and subsequently repaired the pipeline.

Site Inspection Technical Memorandum**:** A Site Inspection Technical Memorandum (SITM) was completed at the AOC FS-13 in 1996 (Aneptek 1996). The SITM consisted of a soil gas survey; trench excavation and soil sampling; soil boring completion and sampling; and monitoring well installation and groundwater sampling.

The trench excavation was performed along the pipeline to locate ruptures. Approximately 900 feet of the pipeline was excavated. No leaks or stained soils were observed. Six trench subsurface soil samples were collected at 3 ft bgs. Samples were analyzed for TCL VOCs, TCL SVOCs, TCL Pesticides/PCBs, TPH, and TAL metals. Several metals were detected above MMR background, however all detections were

below MassDEP S-1/GW-1 soil standards. Dieldrin, however, was detected above MassDEP S-1/GW-1 soil standards in two samples (120 μg/kg and 3,100 μg/kg).

The soil gas survey involved the advancement of 28 soil gas points at the site. Five soil borings were also advanced and sampled at 69-72 ft bgs. Samples were analyzed for TCL VOCs, TCL SVOCs, TCL Pesticides/PCBs, TPH, and TAL metals. Several metals were detected above MMR background, but all detections were below MassDEP S-1/GW-1 soil standards.

Supplemental Site Inspection: An SSI was completed in 2006 to determine if AOC FS-13 Soil Operable Unit (SOU) needed a more comprehensive investigation (i.e., RI). Site characterization activities conducted as part of the SSI included an April 2004 sampling event, October 2004 sampling event, and an April 2005 test pit. Surface and subsurface soil samples were collected and analyzed for EPH/VPH, TCL VOCs, TCL SVOCS, TAL Metals/cyanide, TCL pesticides/PCBs, and EDB. The following risk analyses were completed as part of the 2006 SSI: a human health risk analysis based on residential exposure screening values, an ecological risk analysis, and an impact-to groundwater screening analysis. Each of the risk analyses is discussed below:

Soil data from 0-10 ft bgs was compared to either the EPA Region IX PRGs or the MassDEP S-1/GW-1 soil standards, whichever was more stringent, to determine the potential for human health risk. Soil data from 10-15 ft bgs was compared directly to the MassDEP S-1/GW-1 soil standards to determine if there is a potential for human health risk.

To determine if there is a potential for ecological risk, concentrations of a select number of inorganics were compared to the most stringent STCLs calculated for the development of RALs for the SARAP. Maximum concentrations of PCBs were compared to the RAL of 1 mg/kg established for the SARAP (AFCEE 2003). Concentrations of organics were compared to the most stringent of the following: HECs (mammals/avians) presented in Table F-2 of the MMR RAH (ASG 1993), critical soil concentrations (terrestrial

vegetation) presented in Table O-3 of the MMR RAH (ASG 1993), and invertebrate screening levels in Oak Ridge National Laboratory Guidance (Efroymson1997).

To determine if there is a potential for contamination leaching from soil to groundwater, soil data (>15 ft bgs) was compared to the more stringent of EPA Region IX Soil Screening Levels based on a Dilution Attenuation Factor of 1 and MassDEP S-3/GW-1 soil standards.

No further action was recommended for AOC FS-13 based on the analysis of sampling data collected from the site characterization efforts of the 1996 SITM and the 2006 SSI. Risk was conservatively evaluated to avoid future site land-use restrictions. Detected analytes were compared to residential risk-based human health screening criteria, ecological risk-based criteria, and leaching values for the soil-to-groundwater pathway. Several ecological and human health risk-based COPCs were identified; however each COPC was individually evaluated and did not become a COC due to several factors including: low detection frequency, low average concentration, and comparison of detections with background values (if applicable).

B. Remedial/Removal Actions

This section presents the regulatory actions for AOC FS-13 SOU. Remedy description and RAOs are not applicable for AOC FS-13 Soil.

B.1. Regulatory Actions

Decision Document: A Decision Document was prepared to document the no further action decision for AOC FS-13 Soil (AFCEE 2006a). The no further action decision was based on the findings of the 1996 SITM and the 2006 SSI.

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed for AOC FS-13 Soil since the last five-year review.

- An SSI was completed in July 2006. The SSI included a soil investigation and risk analysis. The SSI was compiled into an SSI Report (AFCEE 2006b).
- A Decision Document was completed in September 2006 (AFCEE 2006a) to document a no further action decision.
- AOC FS-13 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the selected remedy or decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the no further action decision is still applicable for AOC FS-13 Soil.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: MassDEP has re-evaluated S-1/GW-1 soil standards since the decision document was finalized in September 2006. The new S-1/GW-1 soil standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. The new MassDEP S-1/GW-1 standards do not change the protectiveness of the decision of no further action.

Changes in Exposure Pathways: There have been no changes in the physical conditions or exposure pathways that would affect the protectiveness of the no further action decision.

Changes in Toxicity and Other Contaminant Characteristics: MassDEP has re-evaluated S-1/GW-1 soil standards since the decision document was finalized in September 2006. The MassDEP S-1/GW-1 soil standards are based on unrestricted use and take into consideration dermal exposure, ingestion exposure, and impact to groundwater. The new MassDEP S-1/GW-1 standards do not change the protectiveness of the decision of no further action.

Changes in Risk Assessment Methods: There have no changes in risk assessment methods.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no information that calls into question of the protectiveness of the no further action decision.

E. Issues

None

F. Recommendations and Follow-Up Actions

None.

G. Protectiveness Statement

The no further action decision for this site is protective of human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. No land-use restrictions are required for the site and the site no longer requires a five-year review.

H. References

AFCEE. 2006a (September). *Fuel Spill-13 (FS-13) Underground Fuel Line Cantonment Decision Document*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2006b (July). *Fuel Spill-13 (FS-13) Underground Fuel Line Cantonment Supplemental Site Inspection*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2003 (January). *Explanation of Significant Differences Area of Contamination CS-10 (A, B &E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; and SD-3 /FTA-3/CY-4.* Prepared by Engineering Strategies Corporation and Portage Environmental Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

Aneptek. 1996 (March). *Site Inspection Technical Memorandum, Fuel Spill Site FS-13; IRP, MMR Cape Cod, MA*. Prepared for ANG Readiness Center, Andrews Air Force, Maryland.

ASG. 1993 (January). *Risk Assessment Handbook*. Prepared by Automated Sciences Group, Inc., Hazardous Waste Remedial Actions Program, and Oak Ridge National Laboratory, Oak Ridge Tennessee for ANG Bureau, Massachusetts Military Reservation, Massachusetts.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program, Phase I: Records Search.* Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at MMR, Cape Cod. Prepared for HAZWRAP. Portland, Maine.

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997. *Toxicological Benchmarks for Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process*. ES/ER/TM-126/R2. Oak Ridge National Laboratory, Oak Ridge, TN.

EPA. 2001 (June). Comprehensive Five-Year Review Guidance, EPA 540R-01-007.

3.6.28 Fuel Spill No. 18 (FS-18) Source

A. Background

A.1. Site Description. Study Area FS-18, a World War II motor pool and fuel transfer site, is approximately one acre and located at the intersection of Gaffney Street and North Gaffney Street in the Cantonment Area on the MMR (Figure 1-1**)**. Four 5,000-gallon USTs were installed at the study area in 1941. Two tanks, CPT-102 and CPT-103, associated with a fuel-pump island adjacent to Building 3591 stored diesel fuel. Similarly, there were two USTs, CPT-100 and CPT-101, associated with a fuel-pump island at Building 3594, stored motor vehicle gasoline. Three motor VMBs, Buildings 3592, 3593, and 3595, were also part of Study Area FS-18 motor pool.

A.2. Initial Response

Drainage Structure Removal Program: A total of nine drainage structures and approximately 430 cubic yards of surrounding soil were removed as part of the DSRP in 1996 (AFCEE 1996). The excavated soil was treated in an on-site asphalt batching facility (AFCEE 1998).

A.3. Basis for Taking Action

Preliminary Assessment: This study area was identified in the Task 6 Records Search as an area of potential contamination (E.C. Jordan Co. 1986).

Site Investigation: An SI was completed in October 1993 to determine the nature and extent of contamination at AOC FS-18 (ABB-ES 1993). Three monitoring wells were installed during Phase 1 of the field investigation with an additional well installed during Phase 2. Also, as part of the Phase 1 field investigation, 45 soil gas samples were collected and screened for targeted VOCs using a GC. SI soil investigation and sampling at AOC FS-18 focused on three areas: the drainage course south of the study area and

east of South Gaffney Street, the topographic depression west of the study area, and the area around the two former fuel islands and leaching wells. During Phase 1 and Phase 2, six surface soil samples and three subsurface soil samples were collected and submitted for off-site laboratory chemical analysis. During Phase 3, three subsurface samples were recollected and analyzed because hold times were exceeded during previous sampling. In all, three rounds of groundwater samples were completed.

A human health PRE was completed as part of the SI. Arsenic, PAHs, dieldrin, and beryllium were detected above Tier I HECs; however they were all below Tier II HECs, which are based on recreational/older child exposures. Arsenic and beryllium concentrations were consistent with background concentrations. The subsurface soil risk was evaluated using a utility worker exposure scenario. No HECs were exceeded. An ecological PRE was completed to evaluate potential ecological risks associated with exposure to surface soil. Several metals could pose adverse effects to terrestrial receptors; however the concentrations were consistent with background.

The drainage course east of South Gaffney Street was found to be affected by petroleum compounds. Although human health and ecological HECs were not available, qualitative evaluation of petroleum hydrocarbon concentrations indicated a potential effect on human health and ecological receptors. Results of the PRE triggered the need for an evaluation of removal action alternatives (i.e., EE/CA). The COC identified at Study Area FS-18 was petroleum hydrocarbons.

<u>Supplemental Site Investigation</u>: An SSI was completed in 1995. As part of the SSI, an additional monitoring well was installed. A groundwater sample was collected from the new monitoring well and an existing well. Several organic compounds were detected in the new monitoring well, however concentrations was below Tier I HECs. Several inorganic compounds also were detected, but they were below MMR background concentrations. The SSI concluded that based on the qualitative evaluation of the 1995

supplemental sampling data, the PRE for Study Area FS-18 did not need to be revised to include the new data (ABB-ES 1995).

Engineering Evaluation/Cost Analysis: Study Area FS-18 was one of the sites in the Priority 2 and 3 Study Areas and DDOU EE/CA which was issued in October 1998 (AFCEE 1998).

The following alternatives received detailed analysis in the EE/CA:

- Alternative 1: On-Base Thermal Desorption and Off-base Treatment and Disposal;
- Alternative 2: On-Base Asphalt batching and Off-Base Treatment and Disposal;
- Alternative 3: Off-base Treatment and/or Disposal.

B. Remedial/Removal Actions

This section presents the regulatory actions, RAOs, a description of the selected removal action, and a summary of the removal action implementation at AOC FS-18.

B.1. Regulatory Actions. Described below are the controlling documents that present the selected removal action and post-EE/CA documents that identified changes to the selected removal action.

Action Memorandum: The Priority 2 and 3 Study Areas and DDOU Source Removal AM (AFCEE 1999) documented the decision to perform a removal action at AOC FS-18. Based on the evaluation of removal action alternatives presented in the EE/CA, the selected alternative was Alternative 2 which included excavating Study Area FS-18 soil and treating the excavated material on-base using an asphalt batching facility and/or off-base at an approved treatment and disposal facility.

Action Memorandum Addendum: Priority 2 and 3 Study Areas and DDOU Source Removal AM Addendum (AFCEE 2003) was prepared to document changes to the

selected removal action for AOC FS-18. Three changes were made to the selected removal action presented in the Priority 2 and 3 Study Areas EE/CA: (1) establishment of RALs for certain aliphatic and aromatic hydrocarbons; (2) removal of the asphalt-batching component from the selected removal action; and (3) the expansion of offsite disposal options to include RCRA Subtitle D facilities.

B.2. Removal Action Objectives. The RAOs are the site-specific qualitative goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. Investigations conducted at AOC FS-18 demonstrated that surface soil contaminated with TPHs may pose unacceptable risk to humans and ecological receptors.

The TPH cleanup standard was replaced with the MassDEP S-1/GW-1 standards for EPH/VPH. The change in cleanup standards was documented in the AM Addendum (AFCEE 2003). Presented in Table B-1 are EPH/VPH standards that must be achieved to meet remedial response objectives for AOC FS-18.

Table B-1
MassDEP S-1/GW-1 Standards for Petroleum Hydrocarbons

Type of Petroleum Hydrocarbons	Basis	RAL (mg/kg)
Aliphatic Hydrocarbons		
C_5 through C_8 Aliphatic Hydrocarbons	Human Health	100
C_9 through C_{12} Aliphatic Hydrocarbons	Human Health	1,000
C_9 through C_{18} Aliphatic Hydrocarbons	Human Health	1,000
C_{19} through C_{36} Aliphatic Hydrocarbons	Human Health	2,500
Aromatic Hydrocarbons		
C_9 through C_{10} Aromatic Hydrocarbons	Human Health	100
C_{11} through C_{22} Aromatic Hydrocarbons	Human Health	200

B.3. Removal Action Implementation. AFCEE conducted pre-design activities for AOC FS-18 in 2001. Surface and subsurface soil samples were collected and analyzed for EPH/VPH. Concentrations of EPH/VPH did not exceed MassDEP S-1/GW-1 standards. Sampling results were documented in the Phase I Remedial Action Work Plan (AFCEE 2002). The no further action decision was documented in the Removal Action Report (AFCEE 2004).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review:

- Study Area FS-18 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).
- Removal Action Report completed April 2004 (AFCEE 2004).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No further action was required based on pre-remedial design sample results.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: MassDEP has re-evaluated S-1/GW-1 soil standards since the last five-year review. The new S-1/GW-1 soil standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. No cleanup levels for chemical compounds identified as COCs for AOC FS-18 have decreased numerically

during this five-year period. The new MassDEP S-1/GW-1 soil standards do not change the protectiveness of the no further action decision.

Changes in Exposure Pathways: There have been no changes in the physical conditions or exposure pathways that would affect the protectiveness of the no further action decision.

Changes in Toxicity and Other Contaminant Characteristics: MassDEP has re-evaluated S-1/GW-1 standards for EPH/VPH since the last five-year review. The MassDEP S-1/GW-1 standards are based on unrestricted use and take into consideration dermal exposure, ingestion exposure, and impact to groundwater.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the no further action decision.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision (based on pre-design sampling) currently protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1995. *Supplemental Sampling Report for Priority 2 and 3 Study Areas Sites*; Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

______. 1993 (October). *Priority 2 and 3 Study Areas Site Investigation*, Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2004 (April). *Final Removal Action Report Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Area*. Prepared Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2003 (February). *Action Memorandum Addendum Priority 2 and 3 Study Areas and Drum Disposal Unit Source Removal*. Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2002 (May). *Final Phase I Remedial Action Work Plan*. Prepared by Environmental Chemical Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 1999 (June). *Action Memorandum Priority 2 and 3 Study Areas and Drum Disposal Operable Unit Source Removal*. Prepared by Harding Lawson Associates (HLA) for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 1998 (October). *Priority 2 and 3 Study Areas Drum Disposal Operable Unit Engineering Evaluation/Cost Analysis*. Prepared by HLA for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 1996 (January). *Soil Target Cleanup Levels, DSRP*. Prepared by HAZWRAP for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6*; Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.29 Fuel Spill No. 25 (FS-25) Source

A. Background

A.1. Site Description. Study Area FS-25 covers approximately 1 acre of the southeast portion of the MMR at Otis ANG Base, Massachusetts. The study area consists of a parking area located immediately northeast of Building 167 on Izzea Street (Figure 1-1).

A.2. Initial Response. In November 1989, excavation for upgrading the parking area adjacent to Building 167 revealed petroleum-stained soils. Reportedly, some of the soils had a diesel fuel-like odor which was further substantiated by positive readings on a field PID. Under direction of the Otis ANG Base civil engineering staff, approximately 2,000 cubic yards of soil were excavated and temporarily stockpiled on abandoned Taxiway E. The age and source of the soil staining are unknown. Possible sources of identified petroleum contamination include heavy equipment maintenance, refueling operations, and/or runoff from the nearby flightline area.

A.3. Basis for Taking Action. Environmental restoration at Study Area FS-25 followed the CERCLA SI process. Provided below is a summary of investigations performed at Study Area FS-25.

<u>Test Pit Sampling and Soil Boring at Excavation</u>: In December 1989, nine test pits were excavated at the Study Area FS-25. Soil exposed by test pit excavation was monitored for evidence of VOC contamination with a PID. Six soil samples were collected at locations of the six highest PID readings. The six samples from the test pits were analyzed for TCL VOCs, TCL SVOCs, TAL inorganics, and TPH. Five soil borings were also completed at the excavation in December 1989, to evaluate the vertical distribution of contaminants in soil and to supplement test pit data relating to the lateral distribution of contaminants. Samples were analyzed for metals and TPH. Low concentrations of metals and TPH were detected.

Based on comments submitted by EPA on the Technical Report (E.C. Jordan Co. 1991a) and Feasibility Study (E.C. Jordan Co. 1991b), additional samples were collected by the ANG from the excavation. Samples were analyzed for organic and inorganic analytes.

Data from the sampling events were used to perform a risk evaluation. The risk analysis was based on occupational (i.e., worker) use. Risk for the test pits were far below the EPA target risk range for carcinogens and the HI for noncarcinogens.

Excavated Soils: The soil excavated from Study Area FS-25 was staged on Taxiway E in three columns of contiguous dump-truck piles, approximately 5 feet high. A feasibility study (E.C. Jordan Co. 1991b) and a technical report were completed to address the excavated soil. The remedial objective for Study Area FS-25 soil was developed on the assumption that the soil would be moved from Taxiway E and possibly placed back in the excavation. The NGB, in consultation with the EPA, backfilled the FS-25 excavation with soils found to contain a TPH concentration below the revised target clean up level; that location is now paved with asphalt. Approximately 100 cubic yards of soil evaluated to have TPH concentrations exceeding the target clean up level were treated as part of the thermal treatment of soils from AOC FTA-1 and AOC CS-4 (ABB-ES 1992).

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area FS-25.

Decision Document: A Decision Document documenting the no further action decision was finalized in June 1997 (ABB-ES 1997). The no further action decision was based on soil sampling and excavation activities. The no further action decision was also based on the risk analysis which considered current and anticipated land use scenarios.

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- Study Area FS-25 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action functioning as intended by the decision documents?

A soil excavation was performed at Study Area FS-25; however it was not part of the no further action decision document.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action selection still valid?

Changes in Standards and To-Be Considered: MassDEP has re-evaluated S-1/GW-1 soil standards since the decision document was finalized in June 1997. The new S-1/GW-1 soil standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. The new MassDEP S-1/GW-1 standards do not change the protectiveness of the decision of no further action.

Changes in Exposure Pathways: There have been no changes in the physical conditions and exposure pathways of the site that would affect the protectiveness of the no further action decision for Study Area FS-25.

Changes in Toxicity and Other Contaminant Characteristics: MassDEP has re-evaluated S-1/GW-1 soil standards since the last five-year review. The MassDEP S-1/GW-1 soil standards are based on unrestricted use and take into consideration dermal exposure, ingestion exposure, and impact to groundwater. The new MassDEP S-1/GW-1 standards do not change the protectiveness of the decision of no further action.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies that have triggered the need to evaluate the validity of the no further action decision.

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the no further action for FS-25 Source (soil) based on current land use. This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USGS land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1997 (June). *Decision Document Fuel Spill Site 25 (FS-25) Excavation Site.* Prepared by ABB Environmental Services, Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 1992 (August). *Action Memorandum; CS-4, FS-25, and FTA-1 Study Areas Removal Action*. Installation Restoration Program, Massachusetts Military Reservation; Portland, Maine.

E.C. Jordan Co. 1991a (January). *Technical Report: Study Area FS-25*. Installation Restoration Program, Massachusetts Military Reservation; Portland, Maine.

______. 1991b (January). *Feasibility Study, Study Area FS-25, Source Control Operable Unit.* Installation Restoration Program, Massachusetts Military Reservation; Portland, Maine.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.30 Fire Training Area No. 1 (FTA-1) Source

A. Background

A.1. Site Description. AOC FTA-1 is located 500 feet north of Kittredge Road near the southern boundary of MMR (Figure 1-1). The AOC consists of approximately three acres that was used by the MMR fire department for fire-training activities from 1958 to 1985. The AOC was closed in November 1985 because of air emission permitting difficulties. All burning occurred on the ground surface until 1983, when a concrete pad with a soil berm border was built to contain the flammable liquids. Flammable materials burned on-site included jet fuel, diesel fuels, waste oils, solvents, paint thinners, transformer oils, and spent hydraulic fluids. Standard operating procedures at AOC FTA-1 involved leaving flammable material in the pits overnight after a fire training exercise to volatilize and seep into the soil; any flammable material remaining the following day was burned to eliminate potential fire hazards.

A.2. Initial Response. Not applicable.

A.3. Basis for Taking Action. Environmental restoration at AOC FTA-1 followed the CERCLA RI process. Provided below is a summary of investigations performed at FTA-1.

<u>Site Investigations</u>: Three SIs were completed for FTA-1. A field exploration program, completed in 1985, included the excavation of nine test pits and the installation of two monitoring wells in the cleared fire-training area. Soil analyses indicated the presence of oil and grease, organic halogen compounds, and lead (E.C. Jordan Co. 1986). In 1986, soil beneath the study area was investigated (E.C. Jordan Co. 1988). Fuel-related hydrocarbons were detected in shallow soil including BTEX and PAHs. In 1989, soil in the fire-training area was investigated. Petroleum hydrocarbons, BTEX, and chlorinated solvents were detected (E.C. Jordan Co. 1990).

Remedial Investigation: RI activities completed at AOC FTA-1 were intended to develop more refined estimates of the extent of soil contamination and the lateral and vertical extent of groundwater contamination associated with the AOC (ABB-ES 1995). Results of the FTA-1 RI confirmed the presence of fuel- and solvent-related contamination in soil throughout the cleared portion of the AOC and in the sediments and surface water perched in the drainage pit. Residual contamination was highest in soil less than 10 feet deep beneath and adjacent to the concrete pad in the center of the site clearing. Lead was consistently detected at levels greater than 10 times background levels for the MMR, and the water in the drainage pit exceeded the state and federal MCLs for lead.

A human-health PRA was completed to evaluate potential human-health risks associated with exposure to contaminated surface and subsurface soil. The human exposure scenario used for calculating risks for FTA-1 Source consisted of exposure to a child trespasser. Calculated carcinogenic risks were within the EPA target risk range. The calculated noncarcinogenic risk was below the EPA target HI of 1.0.

Engineering Evaluation/Cost Analysis: AOC FTA-1 was included as part of the CS-4, FS-25, FTA-1 EE/CA completed in May 1991 (ABB-ES 1991).

The following alternatives received detailed analysis in the EE/CA:

- Alternative 1: Land Treatment/Off-Site Incineration for AOC FTA-1
- Alternative 2: Thermal Treatment for AOC FTA-1

B. Remedial/Removal Actions

This section presents the regulatory actions, RAOs, and remedy description for AOC FTA-1.

B.1. Regulatory Actions.

Action Memorandum: Based on information presented in the EE/CA, the selected removal action alternative was Alternative Two, excavation and thermal treatment of AOC soil. The decision was documented in an AM (ABB-ES 1992).

B.2. Removal Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. Based on calculations from the risk assessment; it was concluded that no significant human health risks were associated with exposure to FTA-1 study area soil. However soil at this study area was considered a source of groundwater contamination. The following RAO was developed based on these considerations:

- Remove 12,800 cubic yards of soil from the FTA-1 Study Area to eliminate sources of groundwater contamination.

B.3. Remedy Implementation. Treatment of contaminated soil at the AOC FTA-1 Source began in June 1995. Approximately 22,000 tons of soil were excavated and treated between June 1995 and May 1996. Soil treatment was delayed in 1997 as a result of a fire on February 26, 1997. Thermal treatment resumed on June 30, 1997 and was completed on September 8, 1997. A total of approximately 49,000 tons of contaminated soil was treated by the Thermal Treatment program at AOC FTA-1. The FTA-1 Closure Report was completed for the removal action (AFCEE 2000).

C. Progress Since the Last Five-Year Review

No noteworthy activities have been conducted at the FTA-1 Study Area since the last review.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents, site inspections and the site closure report demonstrate that the removal action is functioning as intended by the AM.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been no changes in standards and to-be considered guidance.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in the toxicity factors and other contaminant characteristics.

Changes in Risk Assessment Methods: There were no changes in HHRA methodology.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the removal action conducted at FTA-1 Source based on current land use. This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1995 (September). *Task 2-5, Remedial Investigation Report Area For Contamination Fire Training Area No. 1 (AOC FTA-1) Source Operable Unit.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

_____. 1992 (August). *Action Memorandum AOCs CS-4, FS-25, & FTA-1 Source Removal.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

_____. 1991 (September). *Engineering Evaluation/Cost Analysis CS-4, FS-25 and FTA-1 Study Areas Removal Action.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2000 (July). *Final Closure Report FTA-1 Site.* Prepared by Jacobs Engineering Group Inc. for the AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1990 (July). *Site Inspection Report, Field Investigation Work Conducted Spring-Summer 1988, Task 2-3B.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

_____. 1988 (July). *Field Investigations-Summer/Fall 1986, Task 2-1, Base Landfill, Petroleum Fuel Storage Area, and Fire-Training area, Volume I – Study*. Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

_____. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.31 Fire Training Area No. 2 (FTA-2)/Landfill No. 2 (LF-2) Source

A. Background

A.1. Site Description. AOC FTA-2/LF-2 is located approximately 250 feet west of the southern end of Runway No. 5, within the flightline security area. The AOC occupies approximately 11 acres, and includes a former fire-training area developed on top of a buried industrial/municipal landfill. Landfill operations at LF-2 began in approximately 1940 and were discontinued in 1944. LF-2 contained solid waste (e.g., bottles, glass, ash, metal scrap, wood, concrete, and asphalt construction debris). The landfill was covered with fill material before the fire-training site was developed in 1948. Fire-training activities at FTA-2 began in an unlined depression on the southern part of the landfill. Sand, asphalt, and concrete rubble fill were apparently placed in the landfill swale before, during, and after fire-training activities. FTA-2 was covered with additional soil following its abandonment in 1956.

A.2. Basis for Taking Action. Environmental restoration at AOC FTA-2/LF-2 followed the CERCLA remedial action process. Provided below is a summary of investigations performed at AOC FTA-2/LF-2.

<u>Preliminary Assessment</u>: As part of the PA conducted in 1986 for the IRP at the MMR, AOC FTA-2/LF-2 was identified as a potential site of past uncontrolled disposal of hazardous substances (E.C. Jordan Co. 1986).

<u>Site Investigation</u>: An initial SI was completed in 1984 (R.F. Weston Inc. 1985) and a follow-on SI was completed in 1988 (E.C. Jordan Co. 1990). The SI and follow-on SI consisted of a soil gas survey, excavation of 18 test pits, installation of two soil borings completed as monitoring wells, soil sampling, and groundwater sampling. The soil gas survey detected trace concentrations of chlorinated solvents. Test pits identified areas of burned refuse and stained soil.

Remedial Investigation: The RI (ABB-ES 1996) included the excavation of four test pits, geophysical investigations, surface soil sampling, subsurface soil sampling, and groundwater sampling. Samples were analyzed for VOCs, SVOCs and inorganics. The Supplemental RI focused on investigating subsurface soil associated with the firefighter training site. In summary, RI data indicated that the primary soil contaminants of AOC FTA-2/LF-2 were fuel-related VOCs and SVOCs. Inorganics are secondary contaminants at the site. The highest concentrations of VOCs and SVOCs were observed at the FTA-2 burn pit.

The RI included a human-health PRA to evaluate potential human-health risks associated with exposure to contaminated soil under an occupational (worker) exposure scenario. The calculated cancer risk was within the EPA acceptable risk range and the calculated noncancer hazard index was below one. An ecological PRA was also performed. There could be adverse affects to ecological receptors, however because of current and anticipated land use of the site, no additional action was recommended. Cleanup at AOC FTA-2/LF-2 was driven by impact to groundwater by petroleum-related organic compounds.

Feasibility Study: AOC FTA-2/LF-2 was included as part of the Six Areas of Contamination Source Area FS completed in November 1997 (AFCEE 1997). The following alternatives received a detailed analysis in the feasibility study:

- Alternative One: No action
- Alternative Two: Limited action
- Alternative Three: Biosparging with Ambient Air Monitoring

B. Remedial Actions

This section presents the regulatory actions, RAOs, a description of the selected remedy, and a summary of the remedy implementation at AOC FTA-2/LF-2.

B.1. Regulatory Actions.

Record of Decision: A ROD was finalized in September 1998 (AFCEE 1998) which documented the decision to perform a remedial action at AOC FTA-2/LF-2. The selected remedial alternative was Alternative Three: Biosparging with Ambient Air Monitoring. In summary, the remedy provides for:

- Performance of baseline ambient air monitoring;
- Collecting confirmation soil samples to refine the horizontal and vertical delineation of the target contaminants ethylbenzene and total xylenes;
- Designing and installing a full-scale biosparging treatment system;
- Collecting ambient air samples to assess compliance with ARARs;
- Maintaining institutional controls that restrict site access and limit potential human exposure to contaminants.

B.2. Remedial Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. Investigations conducted at the AOC FTA-2/LF-2 indicated that source area soil may be a source of release of ethylbenzene and total xylenes to groundwater. Such a release could result in an unacceptable risk to those who drink groundwater at or downgradient of the source area. Therefore the MMR-specific STCLs established for the DSRP (AFCEE 1996) were retained and used to develop cleanup level concentrations for identified COCs. COCs and respective cleanup levels are presented in Table B-1. Specifically, the RAO established for AOC FTA-2/LF-2 is:

- Reduce ethylbenzene and total xylenes concentrations in FTA-2/LF-2 subsurface soil to less than the leaching-based STCLs of 700 and 10,000 μg/kg, respectively, in order to prevent them from acting as a source of groundwater contamination.

Table B-1 COCs and Respective Cleanup Levels for AOC FTA-2/LF-2			
COC	**Basis**	**Concentration (µg/kg)**	**Standard**
Ethylbenzene	Leaching Potential	700	MMR-Site-Specific
Total Xylenes	Leaching Potential	10,000	MMR Site-Specific

B.3. Remedy Implementation. The biosparge treatment system at AOC FTA-2/LF-2 began operation in September 2001 and was shut down in May 2003. The treatment system consisted of an air compressor, a regenerative blower, a moisture separator, a heat exchanger, carbon vessels and a condensate-holding tank. The system design combined 90 cubic feet per minute (cfm) of sparging capacity with 180 cfm of extraction capacity. The system was also used to treat VOCs at SD-5/FS-5 (AFCEE 2002).

B.4. Post –Remedial Action Activities.

<u>Groundwater Sampling Event (December 2004)</u>: In December 2004, under the Western Aquafarm groundwater monitoring program, isomers of trimethylbenzene (TMB) were detected in two monitoring wells located at the LF-2/FTA-2. In subsequent discussions with EPA and MassDEP, it was determined that the TMB detections would be more appropriately addressed under the LF-2/FTA-2 groundwater monitoring program (AFCEE 2005a).

<u>Groundwater Sampling Event (October 2005)</u>: Eleven groundwater monitoring wells were sampled at FTA-2/LF-2 in October 2005. Samples were analyzed for TAL inorganics, TCL VOCs (including TMB), TCL SVOCs, EPH/VPH, pesticides, and PCBs. Eight of 11 locations had EPH/VPH concentrations above MCP GW-1 standards. Arsenic was detected above the MCP GW-1 standard at five locations. The arsenic

detections could be the result of reducing conditions in groundwater due to the presence of EPH/VPH. Pesticides, PCBs, SVOCs, and other VOCs were not detected above MCP GW-1 standards (AFCEE 2005b).

<u>Groundwater Sampling Event (January 2006)</u>: Ten groundwater samples were collected using Geoprobe® at the FTA-2/LF-2 source area in January 2006. All groundwater samples were analyzed for TAL inorganics, TCL VOCs (including TMB), TCL SVOCs, EPH/VPH, pesticides, and PCBs. Arsenic and C_{11}-C_{22} aromatic hydrocarbons were detected in one sample at concentrations that exceed MCP GW-1 standards. SVOC contamination at TP-16, located within the LF-2/FTA-2 boundaries, was never addressed in the ROD. Six sampling locations were selected down gradient and in the vicinity of TP-16 to determine if there is any impact to groundwater. SVOCs were not detected, however, chromium, arsenic, and vanadium were detected at concentrations that exceed the MCP GW-1 standards.

<u>Groundwater Sampling Event (November 2006)</u>: Sixteen groundwater monitoring wells at AOC FTA-2/LF-2 were sampled and analyzed for EPH/VPH and the two isomers of TMB in November 2006. Six of the 16 samples had EPH/VPH contamination that exceeded MCP GW-1 standards (AFCEE 2006).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- The Biosparge Treatment System was shutdown in May 2003.
- Post Remedial Action Groundwater Sampling Events (December 2004, October 2005, January 2006, November 2006).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The biosparging system has mitigated impact to groundwater from COCs identified in the ROD. However, EPH/VPH were detected in subsurface soil and groundwater above MassDEP cleanup standards. AFCEE is currently planning to collect additional data to determine the nature and extent of EPH/VPH contamination in groundwater at FTA-2/LF-2.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been changes in MassDEP standards for soil; however the ROD soil cleanup levels for xylenes and ethyl benzene are much more stringent.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the removal action.

Changes in Toxicity and Other Contaminant Characteristics: EPH/VPH have been identified as contaminants in subsurface soil and groundwater (Post-ROD). AFCEE is planning to collect additional data to determine the nature and extent of EPH/VPH contamination.

Changes in Risk Assessment Methods: There were no changes in risk assessment methodology.

Review of RAOs: RAOs need to be modified to include the requirement to address EPH/VPH and TMB.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy/removal action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the removal action based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

(1) As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

(2) EPH/VPH have been identified as contaminants in subsurface soil and groundwater. However, exposure to contaminated groundwater is not an immediate threat to human health based on current land and groundwater use.

F. Recommendations and Follow-Up Actions

Recommendations:

(1) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

(2) Determine nature and extent of EPH/VPH contamination at FTA-2/LF-2.

Follow-Up Actions: Conduct groundwater sampling to determine the nature and extent of EPH/VPH contamination at LF-2/FTA-2.

G. Protectiveness Statement

The remedy selected for AOC LF-2/FTA-2 is protective of human health under a worker exposure scenario. Operations of the biosparge/SVE system also mitigated the leaching of COCs indentified in the ROD (confirmed by groundwater sampling). EPH/VPH have been detected in groundwater, however exposure to humans is mitigated by current land use and contaminated groundwater is not migrating.

H. References

ABB-ES. 1996. *Remedial Investigation Report Fire-Training Area No.2 (FTA-2) and Landfill No.2 (LF-2).* Prepared for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

AFCEE. 2006. *Project Note No. LF2FTA2PN101806: November 2006 Landfill-2 (LF-2) Fire Training Area -2 (FTA-2) Monitoring Well Sampling Event.* Prepared by Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, Cape Cod MA.

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______. 2005b (December). *Project Note No. FTA2LF2PN120805: October 2005 Landfill-2 (LF-2)/ Fire Training Area-2 (FTA-2) Monitoring Well and Biosparging Well Sampling Results.* Prepared by Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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E.C. Jordan Co., 1990, "*Task 2-5B Site Inspection, Field Investigation Work Conducted Spring-Summer 1988'; Installation Restoration Program;* Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine; June 1990.

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EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

R.F. Weston, Inc., 1985 (October). *Installation Restoration Program: Phase II, Stage 1-Confirmation/Quantification.* Prepared for the U.S. Air Force Occupational and Environmental Health Laboratory Otis ANG Base, Massachusetts.

3.6.32 Landfill No. 1 (LF-1) Source

A. Background

A.1. Site Description. AOC Main Base LF-1 Source Area is located in the southern portion of MMR and is bounded by Turpentine Road to the east, Frank Perkins Road to the west, Herbert Road to the north, and Connery Avenue to the south (Figure 1-1). The AOC LF-1 source area, which occupies approximately 100 acres of open to heavily wooded terrain, began operating in 1944 as the primary solid waste disposal facility at MMR. From the late 1940s until 1984, unregulated disposal activities were conducted at the site; from 1984 to 1993, the NGB regulated disposal at AOC LF-1 as a component of the MMR Hazardous Waste Management Plan. Disposal at the landfill occurred in six areas (i.e., five distinct cells and a natural kettle hole). The cells are designated by the years representing the approximate end date of waste disposal activities. The six disposal areas include the 1947, 1951, and 1957 cells, referred to as the Northwest Operable Unit (NWOU), which occupy approximately 40 acres of the total AOC LF-1 area; and the 1970 and Post-1970 cells and the Kettle Hole, which occupy approximately 50 acres. The remaining 10 acres comprise the space between the cells. The depth of waste burial has not been accurately determined, but is estimated to be 20 ft bgs for the cells; depth to waste in the Kettle Hole in unknown (E.C. Jordan Co. 1988 and 1990). Approximately 100 additional acres were used in and around the site for construction soil material borrow pits, access roads, staging areas, and cross gradient or downgradient surface water recharge areas (i.e., retention/detention basins).

Accurate documentation of the wastes landfilled at AOC LF-1 does not exist. The wastes are believed to include general refuse, fuel tank sludge, herbicides, solvents, transformer oils, fire extinguisher fluids, blank small arms ammunition, paints, paint thinners, batteries, DDT powder, hospital wastes, municipal sewage sludge, coal ash, and possibly live ordnance.

A.2. Initial Response. None.

A.3. Basis for Taking Action. Environmental restoration at AOC LF-1 followed the CERCLA remedial action process. Provided below is a summary of investigations performed at AOC LF-1.

Interim Remedial Investigation: An interim RI was performed from 1987-1989 to further quantify the impact to groundwater downgradient of each landfill cell, to estimate the potential for each cell to be a continuing source of groundwater contamination, and to characterize the initial conceptual model of the plume. A risk assessment of the landfill (all six disposal areas) indicated that there was a potential for human health risks as a result of exposure to source area groundwater and that remedial action should be performed at the landfill to reduce contaminants leaching to groundwater (ABB-ES 1992a).

Remedial Investigation: From 1992-1994 , the LF-1 RI was conducted and was intended to complete the characterization of the extent of subsurface contamination by defining the downgradient (horizontal and vertical) extent of the chlorinated solvent plume, and evaluating the stratigraphy and geology of the region (AFCEE 1996).

Focused Feasibility Study: A focused feasibility study (ABB-ES 1992a) and final design documents (ABB-ES 1993b) addressed remedial objectives, developed remedial alternatives, analyzed alternatives, and developed a detailed remedial design for the LF-1 source area. The design for contaminant source control was based on an interim remedial strategy to reduce contaminant leaching, limit migration of liquids through the landfill cells, and maintain compatibility with final remedial measures.

Feasibility Study: A FS was completed in 2006 (AFCEE 2006b) to identify remedial alternatives for AOC LF-1. Nineteen alternatives were evaluated. As part of the feasibility study, a risk assessment was performed for groundwater and surface water (Buzzards Bay). Soil exposure pathways for humans and ecological receptors at the source area were not evaluated due to the cap and fence already installed at the landfill.

The carcinogenic and noncarcinogenic risk calculations indicated that future residential exposure to LF-1 groundwater within and outside the capture zone are greater than the EPA target risk of $1x10^{-4}$ and HI of 1.0, respectively. The carcinogenic and noncarcinogenic risk calculations indicated that current and future exposure to LF-1 impacted surface water through recreational swimming and recreational fish consumption are within and lower than the EPA acceptable risk range and HI of 1.0.

B. Remedial/Removal Actions

This section presents the regulatory actions, RAOs, remedy description, and implemented remedy for AOC LF-1.

B.1. Regulatory Actions.

Interim Record of Decision: In 1993, EPA approved and MassDEP concurred with the *Record of Decision Interim Remedial Action, Main Base Landfill (AOC LF-1) Source Area Operable Unit* (ABB-ES 1993c). The interim remedial plan, referred to as the preferred alternative, addressed AOC LF-1 source control and recommended a method of minimizing further contamination from occurring using containment options evaluated during the focused feasibility study.

The interim remedial action for the landfill (ABB-ES 1993c) consisted of the following actions:

1. Leaving NWOU wastes in place beneath the soil and vegetative cover and installing downgradient groundwater monitoring wells to assess any impacts from the older cells and to determine if the interim remedial action is an appropriate long-term remedial action.
2. Construction of a landfill cover system of the 1970 Cell, Post-1970 Cell, and the Kettle Hole.
3. Preparation of a post-closure monitoring plan for the 1970 Cell, Post-1970 Cell, and Kettle Hole.

Final Record of Decision: A final remedy for the 1970 Cell, Post-1970 Cell, and Kettle Hole was chosen and documented in the September 2007 Final ROD (AFCEE 2007b). The NWOU (the 1947, 1951, and 1957 cells) will be addressed in a future decision document. The selected final remedy for the LF-1 source area (the 1970-Cell, Post-1970 Cell, and Kettle Hole) provides for continued monitoring and maintenance of the existing landfill cover system. The objective of the remedy is to maintain the integrity of the landfill cover system to retard leaching of contamination that would cause downgradient groundwater to be unusable and implement LUCs to prevent exposure to landfill waste.

B.2. Removal Action Objectives. The final RAOs for the LF-1 source area include (AFCEE 2007b):

- Prevent the leaching from the source area of landfill contamination that would cause groundwater downgradient from the landfill to be unusable; and
- Prevent risks to human health and the environment (if any) posed by the landfill.

B.3. Remedy Implementation. Closure activities at the landfill, including capping three cells and instituting post-closure monitoring, were completed in December 1995 (ABB-ES 1992b). Landfill caps on the three most recently used cells (1970, Post-1970, and Kettle Hole), were constructed because these cells were the apparent sources of groundwater contamination. The primary purpose of the landfill cover and associated drainage structures is to minimize the amount of precipitation that infiltrates the landfill and produces leachate that drains into the aquifer. It is expected that with a properly functioning cover, landfill drainage will become negligible once moisture in excess of the waste's field capacity has drained. The LF-1 cover system is composed of low permeability caps built on top of the three cells, an associated drainage system, and 70 gas vents designed to release gas from the interior of the landfill. Gas probes are located around the perimeter of the caps to monitor subsurface vapor. A perimeter fence already existed around the entire landfill (capped cells and NWOU) at the time of capping.

The Post-Closure Plan for Main Base Landfill (ABB-ES 1993a), outlined the following actions:

1. Post-closure maintenance and monitoring of the cover system is to be conducted for a minimum of 30 years after the completion of cap construction. To verify that the cap maintains its structural integrity, it is inspected for animal burrows, erosion rills, settlement depressions, intrusive vegetation, seeps, and sedimentation in ditches and culverts. Post-closure maintenance is performed any time a loss of integrity is noticed; landfill surveys are performed regularly.

2. Landfill gas and groundwater quality at the landfill are to be monitored as appropriate. The landfill interim remedial action will allow time to further evaluate the environmental impact of the 1947, 1951, and 1957 cells on groundwater quality.

3. The performance evaluation of the interim remedial action occurs regularly.

In 1996, the EPA and MassDEP approved the closure report for the landfill site, thus initiating the LTM program as defined in the Post-Closure Plan. Ongoing post-closure monitoring activities were eventually combined with the SPEIM program for the interim groundwater remedial action (see Section 4.4.14). These activities include sampling groundwater monitoring wells, screening of landfill gas at 12 gas probes surrounding the perimeter of the LF-1 cover system, site inspections, settlement monitoring, periodic maintenance of the cover system (i.e., mowing, repairing animal burrow holes, cleaning out drainage swales, etc.), and LUCs (i.e., ensuring perimeter fence is functional, gates are locked and appropriate signage is maintained). The post-closure activities are documented in several SPEIM reports (AFCEE 2008, 2007b).

C. Progress Since the Last Five-Year Review

The activities conducted/observed since the last review are described in the following documents:

- *Final Landfill-1 2002 Annual System Performance and Ecological Impact Monitoring Report*: September 2003 (AFCEE 2003)
- *Final Landfill-1 2003 Annual System Performance and Ecological Impact Monitoring Report.* May 2004 (AFCEE 2004)

- *Final Landfill-1 2004 Annual System Performance and Ecological Impact Monitoring Report*. July 2005 (AFCEE 2005)
- *Final Landfill-1 Source Area and Groundwater Feasibility Study.* May 2006 (AFCEE 2006a)
- *LF-1 2005 Summary Letter Report.* February 2006 (AFCEE 2006b)
- *Final Record of Decision for Landfill-1 Source Area and Groundwater.* September 2007. (AFCEE 2007a)
- *LF-1/CS-23 2006 Summary Letter Report*. February 2007 (AFCEE 2007b)
- *LF-1/CS-23 2007 Summary Letter Report*. March 2008 (AFCEE 2008)

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents, site inspections and annual system performance and ecological impact monitoring activities demonstrate that the remedy is functioning as intended by the ROD.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been no changes in standards and to-be considered guidance.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in the toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: As part of the FS completed in 2006, an HHRA was performed. The HHRA was completed the most current EPA Region I and MassDEP risk assessment guidance.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the remedial action based on current land use (i.e., DoD and/or USGS). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USGS land use and management practices. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

The Final ROD for LF-1 did not address the NWOU (the 1947, 1951, and 1957 cells) because it was determined that a former gun position associated with the Army's former training program was located in/on the old landfill cells. This gun position may still undergo investigation under the Army's Impact Area Groundwater Study Program and EPA was reluctant to make a final remedy decision for these landfill cells with information regarding the gun position pending.

F. Recommendations and Follow-Up Actions

Long term monitoring as well as landfill cap operation and maintenance activities shall continue as required by the Final ROD. The Air Force, Army, EPA, and MassDEP should develop a plan to resolve the gun position issue on the NWOU with the ultimate

objective of modifying the LF-1 remedy decision to include the NWOU cells. AOC LF-1 shall be reviewed again in five years.

G. Protectiveness Statement

The selected remedy for AOC LF-1 is expected to be protective of human health and the environment upon both its completion and in the interim. Exposure pathways that could result in unacceptable risks are being controlled.

H. References

ABB-ES. 1996 (September). *AOC LF-1 Main Base Landfill Site Closure Report.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Oak Ridge, Tennessee.

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AFCEE. 2008 (March). *LF-1/CS-23 2007 Summary Letter Report*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

______. 2007a (September). *Final Record of Decision for Landfill-1 Source Area and Groundwater.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

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______. 1996 (April). *Final Remedial Investigation Main Base Landfill (AOC LF-1) and Hydrogeologic Region I Study.* Prepared by CDM Federal Programs Corporation for AFCEE/MMR Installation Restoration Program Otis ANG Base, MA.

E.C. Jordan Co. 1990 (February). *Task 2-3B Site Inspection, Field Investigation Work Conducted Spring-Summer 1988*; Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

______. 1988 (July). *Field Investigations, Summer/Fall 1986; Task 2-1; Base Landfill, Petroleum Fuels Storage Area, and Fire-Training Area*; Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

EPA. 2001 (June). Co*mprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.33 Landfill No. 7 (LF-7) Source

A. Background

A.1. Site Description. Study Area LF-7 is approximately 400 square feet and is located in a gravel pit north of AOC LF-1 (Figure 1-1). It is an area where radioactive electron tubes, removed from EC-121 aircraft radar sets, were reportedly buried. The number buried is unknown, however, since approximately 200 tubes/year were removed from aircraft between 1955 and 1970, it is estimated that as many as 3,000 tubes may be buried.

A.2. Initial Response. Not applicable.

A.3. Basis for Taking Action. In response to discussions with the EPA on May 19, 1992, the ANG investigated the nature of the radioactive isotopes used in the radar tubes potentially disposed of at Study Area LF-7. Based in discussions with ANG and Air Force personnel, the most likely radioactive isotopes used in the electron tubes were Cesium-137, Tritium, Nickel-63, Cobalt-60, and Radium-226 (ABB-ES 1993).

These radar electron tubes are believed to have contained very low, near background, levels of radioactive material ranging from 10^{-7} to 10^{-9} picoCuries (pCi). Using the estimated number of tubes and their pCi range, the total radioactivity at this study area is calculated to be $3x10^{-4}$ to $3x10^{-6}$ pCi range. It was concluded that were the entire amount of radioactivity to be contained in one liter of water, the level of radioactivity would be, at worst, $3x10^{-4}$ pCi/L. The EPA Interim Primary Drinking Water Standards for radium and gross Alpha radioactivity are 5 pCi/L and 15 pCi/L, respectively. The worst-case concentrations calculated above are negligible compared to federal standards (ABB-ES 1993).

Because of the uncertainty in the identification of the isotope(s) potentially disposed of at Study Area LF-7, specific discussions regarding the radioactive half-life(s) could not be

made. The half-lives of the likely isotopes used in the radar electron tubes extend from approximately 5 to 1,620 years. Therefore, the radioactivity in these tubes, which were potentially disposed of between 1955 and 1970, were calculated to range from less than 1% to 100% of the amount present at the time of the suspected disposal (ABB-ES 1993).

B. Remedial/Removal Actions

This section presents regulatory actions, a description of the selected remedy, and a summary of the remedy implementation at Study Area LF-7.

B.1. Regulatory Actions. Provided below is the controlling document that presents the selected remedy.

Decision Document (LF-7): The LF-7 Decision Document was completed in November 1993. The Decision Document requires the construction of a fence surrounding the study area to prevent unauthorized entry and excavation activities, the posting of appropriate radioactive warning labels, and the conducting of annual radiological surveys.

B.2. Remedial Action Objectives. Not applicable.

B.3. Remedy Implementation. The study area has operated in full accordance with AFOMS/SGPR policy letter of August 9, 1988. This policy specifies that areas used for disposal of low-level radioactive wastes will be appropriately fenced to prevent unauthorized entry, marked with appropriate radioactive warning labels, and monitored annually to verify that actual levels of radioactivity remain acceptable. In addition to the fencing surrounding the disposal site, and in response to EPA concerns, an area surrounding LF-7 was posted by the ANG to prevent excavation. The annual radiological survey has been conducted since 1990. The 20-foot by 20-foot area been surveyed at the ground surface and three feet above. These institutional controls will be in place as long as MMR remains a military base. Levels of radioactivity considered acceptable are

(1) less than two times background; or (2) 2 milliRoentgen/hr, whichever is lower (Nuclear Regulatory Commission regulations 10 CFR 20.105).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- Completed annual radiological surveys and site inspections as required by the decision document.

D. TECHNICAL ASSESSMENT

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The review of documents and the results of annual site inspections and radiological surveys indicate that the remedy is functioning as intended by the Decision Document. Annual air monitoring has been conducted since 1990 (18 years). There has never been a radiation reading above background levels.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: There have been no changes in standards and to-be considered.

<u>Changes in Exposure Pathways</u>: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There were no changes in toxicity and other contaminant characteristics.

Changes in Risk Assessment Methods: Not applicable

Review of RAOs: Not applicable.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information at this time that calls into the question of the *short-term* protectiveness of the no further action decision based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

A site closure plan needs to be identified.

F. Recommendations and Follow-Up Actions

Identify a site closure plan.

G. Protectiveness Statement

The selected remedy for Study Area LF-7 is protective of human health and the environment under current land use exposure scenarios.

H. References

ABB–ES. 1993 (November). *Decision Document Radar Tube Burial Landfill (LF-7 Study Area)*. Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

EPA. 2001 (June). Co*mprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.34 Petroleum Fuels Storage Area (PFSA)/Fuel Spill No. 10 (FS-10)/ Fuel Spill No. 11 (FS-11) Source

A. Background

A.1. Site Description. The PFSA, located on the north side of South Outer Road has been the main fuel delivery and distribution area for the flightline since the early 1950s. Currently, the facility consists of two ASTs; aboveground fuel distribution lines, pump houses, and truck fill stands. The tanks vary in capacity from 0.5 to 1.2 million gallons. The PFSA serves or has served as the primary storage and distribution center for JP-4 jet fuel, AVGAS, motor gasoline, and No. 2 fuel oil for MMR. The PFSA is located inside the flightline security area. Access is strictly controlled with fences and guard posts, and activities not related to aircraft operations are limited. These site access restrictions are expected to remain in place through the duration of the current lease (expiration date of 2026) and the planned 25-year renewal.

A.2. Initial Response.

<u>Drainage Structure Removal Program</u>: As part of the DSRP, the pump house french drains, the storm-sewer catch basin, and associated contaminated soil were removed in 1993.

<u>Demolition of Buildings and UST Removal</u>: Buildings 170 and 173 were demolished. Building 174 and four associated 50,000-gallon USTs were removed from the PFSA in November 1994.

<u>Fuel Spill Cleanup</u>: In June 1996, heavy rains and a pump failure at the PFSA caused the release of 6,000 gallons of fuel-contaminated water, containing approximately 300 gallons of product (diesel and/or jet fuel). The water and fuel were released to a storm drain leading to the OWS at the head of the SD-2 drainage ditch. In July 1996, AFCEE excavated an estimated 480 cubic yards of fuel-contaminated soil at the PFSA.

A.3. Basis for Taking Action. AOC PFSA/FS-10/FS-11 occupies approximately 12 acres located at and down gradient from the PFSA. Environmental restoration at PFSA/FS-10/FS-11 followed the CERCLA remedial action process. Provided below is a summary of investigations performed at AOC PFSA/FS-10/FS-11.

Preliminary Assessment: As part of the PA conducted in 1986 for the IRP at the MMR, Study Area PFSA/FS-10/FS-11 was identified as a potential site of past uncontrolled disposal of hazardous substances.

Field Investigations and Mashpee Groundwater Investigation: A Phase II confirmation and quantification study was completed in 1985 that documented evidence of fuel-related VOCs in a monitoring well installed downgradient of the PFSA. Petroleum-related compounds and elevated concentrations of inorganics were detected within the bermed areas of the tanks.

Remedial Investigations: The RI program was conducted to characterize the nature and distribution of sediment and soil contamination. This program included a french drain/catch basin sediment sampling and installation of 13 soil borings completed as monitoring wells. Contaminants similar to those found during earlier investigations were detected, and the capillary fringe of the water table was identified as a continuing source of contaminants to groundwater (ABB-ES 1996). The SERGOU RI (ABB-ES 1994) was performed in 1994 to characterize groundwater contamination. The SERGOU RI identified Johns Pond as the primary discharge point for contaminated groundwater migrating from AOC PFSA/FS-10/FS-11.

The RI included a human-health PRA to evaluate potential human-health risks associated with exposure to contaminated soil under an occupational (worker) exposure scenario. The calculated cancer risk was within the EPA acceptable risk range and the calculated noncancer hazard index was below one. Because exposures to ecological receptors are

not anticipated at the PFSA; a quantitative ecological PRA was not completed. Cleanup was driven by impact to groundwater by petroleum-related organic compounds.

Feasibility Study: AOC PFSA/FS-10/FS-11 was included as part of the Six Areas of Contamination Source Area Feasibility Study completed in November 1997 (AFCEE 1997). The following three alternatives received a detailed analysis in the feasibility study:

- Alternative 1: No action
- Alternative 2: Limited action
- Alternative 3: Biosparging with Off-gas Collection and Treatment

B. Remedial Actions

This section presents the regulatory actions, RAOs, a description of the selected remedy, and a summary of the remedy implementation at AOC PFSA/FS-10/FS-11.

B.1. Regulatory Actions.

Record of Decision: The ROD for AOCs FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas was finalized in September 1998 (AFCEE 1998) documented the decision to perform a remedial action at AOC PFSA/FS-10/FS-11. The selected remedial alternative for the PFSA/FS-10/FS-11 included the following components:

- Performance of baseline ambient air monitoring
- Collecting confirmation soil samples to refine the horizontal and vertical delineation of the target contaminants ethylbenzene and total xylenes
- Designing and installing a full-scale biosparging treatment system with off-gas collection and treatment for areas with capillary-fringe contamination
- Designing and installing a bioventing system for areas with shallow vadose zone contamination
- Collecting ambient air samples to assess compliance with ARARs

- Maintaining institutional controls that restrict site access and limit potential human exposure to contaminants

B.2. Remedial Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. Investigations conducted at the AOC PFSA/FS-10/FS-11 demonstrated that source area soil may be a source of release of ethylbenzene and total xylenes to groundwater. Such a release could result in an unacceptable risk to those who drink groundwater at or downgradient of the source area. Therefore the MMR-specific STCLs established for the DSRP (ABB-ES 1996) were retained and used to develop cleanup level concentrations for identified COCs. COCs and respective cleanup levels are presented in Table B-1.

Specifically, the RAO established for AOC PFSA/FS-10/FS-11 was:

- Reduce ethylbenzene and total xylenes concentrations in soil in order to prevent them from acting as a source of groundwater contamination at AOC PFSA/FS-10/FS-11.

Table B-1
COCs and RCLs for AOC PFSA/FS-10/FS-11 Source Areas

COC	Basis	Concentration (μg/L)	Standard
Ethylbenzene	Leaching Potential	700	MMR-Specific
Total Xylenes	Leaching Potential	10,000	MMR-Specific

B.3. Remedy Implementation. The PFSA/FS-10/FS-11 biosparge vapor recovery treatment system began operation in October 2001. The system consists of a mechanical building and a wellfield. The mechanical building contains a central processing unit, air compressor, regenerative blower, moisture separator, heat exchanger, two 500-lb GAC vessels positioned in series, and a condensate-holding tank. The wellfield include a total

of 54 biosparge wells, 22 nested monitoring/observation wells, and 29 extraction wells separated into six zones which encompass both areas of capillary fringe contamination (e.g., the Western Capillary Zone and the Eastern Capillary Zone). Extraction wells were installed to a depth of approximately 30 ft bgs and have a 10-foot screen interval. Biosparge wells were installed to a depth ranging from 60-70 ft bgs and have a 2-foot screen interval.

For design optimization purposes, subsurface soil samples were collected within the AOC PFSA/FS-10/FS-11 in December 2003 and January 2004. Samples were analyzed for total xylenes and ethylbenzene. Samples were also analyzed for EPH/VPH in order to address State concerns regarding these contaminants. EPH/VPHs were detected in several samples. The detections led to additional soil and groundwater sampling for EPH/VPH in subsequent design optimization sampling events.

The biosparging component of the system is currently operating. Operational changes to the system have been based on annual evaluation of data including: (1) concentrations of organics in influent, (2) subsurface soil sampling for petroleum-related compounds, and (3) groundwater sampling results for petroleum-related compounds. Operations and sampling were documented in annual reports.

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review:

- *PFSA/FS-10/FS-11 Biosparge/Soil Vapor Recovery 2006 Annual Report* (AFCEE 2008);
- *PFSA/FS-10/FS-11 Biosparge/Soil Vapor Recovery 2005 Annual Report* (AFCEE 2007);
- *PFSA/FS-10/FS-11 Biosparge/Soil Vapor Recovery 2004 Annual Report* (AFCEE 2005).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedial action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The treatment system has mitigated impact to groundwater from COCs identified in the ROD. Ethyl benzene and xylenes in groundwater are all below MCLs. However, the post-ROD contaminants EPH/VPH were detected in subsurface soil and groundwater. AFCEE is currently operating the biosparging component of the treatment system and is planning to collect additional data to determine the nature and extent of EPH/VPH contamination.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial action selection still valid?

Changes in Standards and To-Be Considered: There have been changes in MassDEP standards for soil; however, the ROD soil cleanup levels for xylenes and ethyl benzene are much more stringent.

Changes in Exposure Pathways: There have been no changes in the physical conditions and exposure pathways that would affect the protectiveness of the remedial action.

Changes in Toxicity and Other Contaminant Characteristics: EPH/VPH have been identified as contaminants in subsurface soil and groundwater (Post-ROD). AFCEE is currently operating the biosparging component of the system and is planning to collect additional data to determine the nature and extent of EPH/VPH contamination.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the implemented remedial action.

Review of RAOs: RAOs need to be modified to include the requirement to address EPH/VPH.

Question C: Has any other information come into light that could call into question the protectiveness of the remedial action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the no further action for PFSA/FS-11/FS-10 based on current land use. Portions of this IRP site are located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

A portion of this site is located outside the installation boundaries. Because, of the current land use of the site, the selected decision remains protective. See Section 3.4.2 for discussion on implementation of land-use controls for IRP sites located outside the installation boundaries.

E. Issues

(1) As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

(2) EPH/VPH have been identified as contaminants in subsurface soil and groundwater. Exposure to contaminated groundwater is not an immediate threat to human health based on current land and groundwater use.

F. Recommendations and Follow-Up Actions

Recommendation: AFCEE determine nature and extent of EPH/VPH contamination at PFSA/FS-10/FS-11.

Follow-Up Actions: Continue operating biosparging component and collect more data to address EPH/VPH contamination at PFSA/FS-10/FS-11.

G. Protectiveness Statement

The remedy selected for AOC PFSA/FS-10/FS-11 is protective of human health under a worker exposure scenario and the environment under current land use exposure scenarios. Operations of the biosparge/SVE system also mitigated the leaching of COCs indentified in the ROD (confirmed by groundwater sampling). EPH/VPH have been detected in groundwater, however exposure to humans is mitigated by current land use and contaminated groundwater is not migrating.

H. References

ABB-ES, 1996 (December). *Final Remedial Investigation Report Petroleum Fuels Storage Area (Including AOCs Fuel Spill no. 10 [FS-10] and Fuel Spill No. 11;* Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine; December 1996.

______. 1994 (August). *Southeast Region Groundwater Operable Unit Remedial investigation Report (Including Region III)*; Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2008 (April). *Petroleum Fuels Storage Area/Fuel Spill-10/Fuel Spill 11 (PFSA/FS-10/FS-11) Biosparge/Soil Vapor Recovery System 2006 Annual Report*. Prepared by Engineering Strategies Corporation and Portage Inc. for the AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2007 (April). *Petroleum Fuels Storage Area/Fuel Spill-10/Fuel Spill 11 (PFSA/FS-10/FS-11) Biosparge/Soil Vapor Recovery System 2005 Annual Report*. Prepared by Engineering Strategies Corporation and Portage Inc. for the AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2005 (October). *Petroleum Fuels Storage Area/Fuel Spill No. 10/Fuel Spill No. 11 (PFSA/FS-10/FS-11) Biosparge/Soil Vapor Recovery System 2004 Annual Report*. Prepared by Engineering Strategies Corporation and Portage Inc. for the Installation Restoration Program; Massachusetts Military Reservation; AFCEE/MMR Otis ANG Base, MA.

______. 1998 (September). *Record of Decision for Areas of Contamination FTA-2/ LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas*. Prepared by HLA for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 1997 (November). *Final Six Areas of Contamination Source Area Feasibility Study*. Prepared by ABB-ES for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.35 Storm Drain No. 1 (SD-1) Source

A. Background

A.1. Site Description.

Study Area SD-1 is a 2,300-foot-long, riprapped drainage ditch that extends southward from the southern MMR boundary toward abandoned cranberry bogs north of Ashumet Pond. Study Area SD-1 received stormwater at its northern end from a 48-inch storm drain, which served portions of the parade ground, and two 72-inch storm drains, which convey overflow stormwater from the AOC SD-5 drainage swale. From 1955 to 1970, contaminants from routine maintenance activities at the EC-121 parking area, as well as accidental fuel spills may have washed into the AOC SD-5 drainage swale. Most of this water likely infiltrated to groundwater through highly permeable soils; however, during major storm events, some of the stormwater may have overflowed into Study Area SD-1. Currently SD-1 is maintained as a storm drain and serves as an overflow for stormwater runoff collected in a retention basin located on base.

A.2. Basis for Taking Action. Environmental restoration at Study Area SD-1 followed the CERCLA SI process. Provided below is a summary of investigations performed at Study Area SD-1.

<u>Preliminary Assessment</u>: A PA conducted in 1986 (E.C. Jordan Co. 1986) identified Study Area SD-1 as a potential area of release of hazardous substances.

<u>Site Inspection</u>: Study Area SD-1 was included in the Tasks 2-3A, 2-3B, and 2-3C SIs at MMR (E.C. Jordan Co. 1989, 1990a, and 1990b). SI activities included a soil gas survey, drilling of two soil borings and installation of two monitoring wells, field-screening of soil samples, collection of groundwater samples, and laboratory analysis of soil and groundwater samples.

Task 2-3A: Two soil borings were completed as monitoring wells (i.e., MW-1 and MW-2) in September 1987, as part of the Task 2-3A site investigation. Four soil samples were submitted from soil boring MW-1 for laboratory analysis. Soil samples were analyzed for TCL VOCs, TCL SVOCs, and TAL inorganics. TCL VOCs and SVOCs were not detected above CRQLs in soil. All TAL inorganics except aluminum, chromium, iron, lead, and zinc were detected at concentrations consistently lower than inorganic background concentrations at MMR. In October 1987, two sediment samples were collected from between riprap blocks within the drainage ditch. Sample SD-1 was collected 20 feet from the storm drain outfalls and sample SD-2 was taken approximately 150 feet from the outfall. These samples were analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL inorganics. Metals and PAHs were detected in sample SD-1. Metals, PAHs, and pesticides were detected in sample SD-2. As part of the Task 2-3A field program groundwater samples were collected from MW-1 in January 1988 and from MW-2 in October 1987. These samples were analyzed for TCL VOCs, TCL SVOCs, and TAL inorganics. No constituents were detected above MCLs.

Task 2-3B: The Task 2-3B soil gas survey was performed in April 1988. Seven probes were installed at 3.5 to 5 ft bgs. The survey focused on soils in the 90-degree bend of the drainage ditch and the old drainage swale near monitoring well MW-2 to determine whether this area may be a source of groundwater contamination. Traces of the target compounds DCE, TCE, TCA, and PCE were detected at concentrations relatively close to the detection limit (i.e., 0.01 μg/L total halocarbons in headspace). Hydrocarbons were not detected (E.C. Jordan Co. 1990a).

Task 2C: In June 1998, six additional sediment samples (i.e., samples SD-3 through SD-8) were obtained at various locations along the drainage channel bed. Sediment samples were collected in those areas within the ditch considered most likely to display contamination. These samples were analyzed for TCL SVOCs, TAL inorganics and pesticides. Total PAH concentrations ranged from below detection to 62.8 mg/kg. With the exception of sample SD-4, PAH contamination decreased moving down the channel

(i.e., from sample SD-1 to sample SD-5). No detectable PAH contamination was found in sediment samples SD-6, SD-7, or SD-8, which were collected from sandy soil south of the riprapped portion of the drainage ditch. Sample SD-4 contained the highest concentration of each PAH compound detected. This sediment sample was collected from between riprap blocks approximately 700 feet from the northern outfall. The sample consisted of soil collected below a congealed, weathered oil layer found beneath approximately 1 foot of sand. The analytical result of sample SD-4 was interpreted as a localized release of oil. There was no indication from the sediment data that fuels were frequently washed through the drainage system (AFCEE 1997). Task 2-3C groundwater samples, collected June 1989, were analyzed for TCL VOCs. The VOC 2-butanone was detected at concentrations of 37 and 87 µg/L in MW-1 and MW-2. 2-butanone was not considered a site-related contaminant and was not evaluated in the PRE (AFCEE 1997). No other VOCs were detected.

Data from the SI was used to perform a human health PRA for the Study Area SD-1. For surface soil, a PRA based on residential use was performed. Subsurface soil was excluded from the human health PRE because the only analytes detected in this depth range were inorganics at concentrations below HECs. Results of the PRA for future residential use (surface soil) total cancer risk for residential risk scenario did not exceed the EPA target risk range, however, it slightly exceeded the MassDEP risk criteria of $1x10^{-5}$. For groundwater, maximum concentrations of contaminants of potential concern were compared to PRE Tier I HECs for human health and to available MCLs. Beryllium was identified as exceeding its Tier I HEC. No compounds exceeded MCLs.

An ecological PRE was also performed for Study Area SD-1. The ecological PRE indicated that there could be risk to ecological receptors due to inorganics in soil; however, because the channel does not provide adequate forage or cover for ecological receptors; it is unlikely that ecological receptors will make significant use of the study area.

MassDEP Concern Regarding Institutional Controls: MassDEP submitted a letter to AFCEE indicating that because the calculated risk for soil based on a residential exposure scenario exceeded the MassDEP cancer risk criteria; institutional controls would be required. AFCEE responded on June 25, 1997 that the Air Force has been granted easements for the use of the channel for the purpose of stormwater drainage. In addition, the property on which Study Area SD-1 is located is leased from the Commonwealth of Massachusetts as military base property until the year 2024.

B. No Further Action Decision

This section presents a summary of the no further action decision for Study Area.

Decision Document: A Decision Document documenting the no further action decision was finalized in December 1997 (AFCEE 1997). The no further action was based on multi-media sampling conducted as part of the SI. The no further action decision was also based on the risk analysis for soil and groundwater based on current and anticipated land and groundwater use scenarios. On February 14, 2000; in an internal memorandum, MassDEP agreed to the no further action decision based on current property use. However in the event that the Air Force terminates its lease on the property, MassDEP expected that the Air Force will fulfill its obligation under the lease agreement with the State (DACA 51-5-75-293, dated 1 July 1974) to decontaminate the property.

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- On December 14, 2007; ACFEE submitted a project note to the regulatory agencies that includes soil sampling and potential risk assessment to confirm that the site is allowable for unrestricted use.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal/remedial action or no further action decision. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedial/removal action functioning as intended by the decision documents?

Not applicable, no remedial/removal action was conducted at Study Area SD-1.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedial/removal action selection still valid?

<u>Changes in Standards and To-Be Considered</u>: MassDEP raised a concern regarding PAH concentrations in soil. MassDEP has re-evaluated S-1/GW-1 and S-2/GW-1 standards for PAHs since the last five-year review. The new S-1/GW-1 and S-2/GW-1 standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)].

<u>Changes in Exposure Pathways</u>: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the no further action decision for Study Area SD-1.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: MassDEP soil standards have changed for several PAHs. The new standards take into consideration toxicity values and other contaminant characteristics.

<u>Changes in Risk Assessment Methods</u>: AFCEE has a submitted a project note to collect soil samples and perform a risk assessment in order to confirm that no further action is required for unrestricted use. AFCEE will use the current MassDEP and EPA risk assessment methodologies.

Review of RAOs: Not applicable, the decision for Study Area is no further action.

Question C: Has any other information come into light that could call into question the protectiveness of the removal/remedial action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the no further action for SD-1 Source (soil) based on current land use. A portion of this IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USGS land use and management practices. The no further action is also protective of ecological receptors. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

A portion of this site is located outside the installation boundaries. Because, of the current land use of the site (i.e., storm drain), the selected decision remains protective in the short term. However, for any portion of the site where hazardous substances, pollutants, or contaminants remain or may remain above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.2 for discussion on implementation of land-use controls for IRP sites located outside the installation boundaries.

E. Issues

(1) As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

(2) MassDEP raised a concern regarding PAH concentrations in soil. AFCEE has a submitted a project note to collect soil samples and perform a risk assessment in order to confirm that no further action is required for unrestricted use.

F. Recommendations and Follow-Up Actions

Recommendation: AFCEE collect additional samples and perform a risk assessment to address MassDEP concerns regarding potential PAH contamination.

Follow-Up Actions: AFCEE has submitted a project note which includes soil sampling and a risk analysis to confirm the validity of the no further action decision.

G. Protectiveness Statement

The no further action decision for this site currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

AFCEE. 1997 (December). *Decision Document Study Area SD-1 Runway/Aircraft Maintenance Storm Drainage Ditch.* Prepared by ABB Environmental Services, Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1990a (February). *Task 2-3B Site Inspection Report, Field Investigation Work Conducted Spring-Summer 1988.* Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

______. 1990b (December). *Site Inspection Report Addendum, Task 2-3C, Results of Additional SI Sampling Conducted Summer 1989.* Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

1989 (March). *Site Inspection Report Task 2-3A, Field Investigation Work Conducted Fall 1987.* Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

______. 1986 (December). *U.S. Air Force Installation Restoration Program Phase I: Records Search, Air National Guard, Camp Edwards, U.S. Air Force, and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for Oak Ridge National Laboratory; Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

3.6.36 Storm Drain No. 2 (SD-2)/Fuel Spill No. 6 (FS-6)/Fuel Spill No. 8 (FS-8) Source

A. Background

A.1. Site Description. AOC SD-2/FS-6/FS-8 consists of a storm drainage ditch (SD-2) that extends from the southern boundary of MMR at South Outer Road, south-southwest toward Ashumet Pond. Two 42-inch diameter storm drains and an OWS discharged to the upstream end of SD-2 until their removal in 2002. AOC SD-2/ FS-6/FS-8 had received stormwater discharge from the MMR runway/aircraft maintenance ramp storm sewer system since 1950 (Figure 1-1). The storm sewer system had collected stormwater from approximately 80 acres of concrete and asphalt paved surfaces, hangar nose docks, and support buildings. In the early 1960s, two AVGAS fuel spills (i.e., FS-4 and FS-8) occurred on the aircraft maintenance ramp, resulting in the release of approximately 23,000 gallons of fuel. Reportedly, the spills were washed directly to the storm sewer and discharge to the SD-2 storm drainage ditch.

Other historical sources of contamination reported at AOC SD-2/FS-6/FS-8 were (1) the release of large quantities (i.e., up to 500,000 gallons) of petroleum distillate solvent (i.e., PD-680) on the aircraft maintenance ramp; (2) the release of unknown quantities of TCE, 4-methyl-2-pentanone, 2-butanone, toluene, and possibly 1,1,2,2-TeCA at nose docks or maintenance shops adjacent to the ramp; and (3) other fuel spills, including an estimated 3,000 gallons of AVGAS from EC-121 aircraft fuel dump valve accidents inside Hangar 165. These releases were likely washed to the storm sewer discharging to the SD-2 storm drainage ditch. In 1968, an OWS was constructed (demolished in 2002) at the storm sewer outfalls to intercept fuels from the aircraft maintenance ramp (E.C. Jordan Co. 1986). The adjacent AOC PFSA/FS-10/FS-11 also contains storm sewers that discharged to AOC SD-2/FS-6/FS-8, and may have contributed contaminants to it.

A.2. Initial Response. In June 1996, heavy rains and a pump failure at the PFSA caused the release on an estimated 6,000 gallons of fuel-contaminated water, containing approximately 300 gallons of product (diesel and/or jet fuel) from a fuel pump house at the PFSA. The water and fuel were released to a storm drain leading to the OWS at the head of the SD-2 drainage ditch. Because of high stormwater flows, some of the fuel passed through the OWS and was discharged to the SD-2 drainage ditch. In accordance with the MCP and the Immediate Response Action Plan (RTN 4-12276) submitted to the MassDEP on July 1996, AFCEE excavated an estimated 480 cubic yards of fuel-contaminated soil at the PFSA, and approximately 120 cubic yards of fuel-contaminated soil in the SD-2 drainage ditch.

A.3. Basis for Taking Action. Environmental restoration at SD-2/FS-6/FS-8 followed the CERCLA remedial action process. Provided below is a summary of investigations performed at AOC SD-2/FS-6/FS-8.

<u>Field Investigations and Mashpee Groundwater Investigation</u>: AOC SD-2/FS-6/FS-8 has been investigated several times since 1985. During the 1986 field investigation, one surface water and one sediment sample were collected immediately downgradient of the former OWS for laboratory analysis. The sampling and analysis program detected SVOCs, pesticides, and PCBs in the sediment sample (E.C. Jordan Co. 1988).

As part of the Mashpee groundwater study, a monitoring well was installed just downgradient of the former OWS at the head of the ditch. Six groundwater sampling events did not detect TCL fuel-related organic chemicals in this monitoring well (E.C. Jordan Co. 1990).

During the 1988 SI, two monitoring wells were installed to investigate the potential for groundwater contamination. Six sediment samples were collected from the storm drainage ditch between the OWS and the mouth of the ditch; SVOCs and PCBs were detected. Based on results of the SI, AOC SD-2/FS-6/FS-8 was recommended for an RI (E.C. Jordan Co. 1990).

<u>RI and Supplemental RI</u>: The 1989 RI program for AOC SD-2/FS-6/FS-8 was designed to (1) characterize the distribution of groundwater contamination, and (2) complete characterization of sediment in the SD-2 drainage ditch (ABB-ES 1996). Four sediment samples were collected within the alluvial fan at Ashumet Pond and three groundwater samples were collected from the monitoring wells located in the ditch for laboratory analysis. In 1993, a supplemental RI program was completed to address regulatory agency concerns. The supplemental RI included collection of seven sediment samples and analysis for TCL VOCs (ABB-ES 1996).

The RI report for AOC SD-2/FS-6/FS-8 included a human-health PRA to evaluate potential human-health risks associated with exposure to contaminated surface soil and sediment under a future residential exposure scenario. Subsurface soil was not evaluated. The calculated cancer risk was within the EPA acceptable risk range and the calculated noncancer hazard index was below one. An ecological PRA was also completed to evaluate potential ecological risks associated with exposure to contaminated surface soil and sediment (0 to 2 ft bgs). The results of the ecological PRA triggered the need for an evaluation of remedial alternatives (i.e., feasibility study). The ecological risk-based COCs identified at AOC SD-2/FS-6/FS-8 were chromium, lead, and zinc.

<u>Feasibility Study</u>: AOC SD-2/FS-6/FS-8 was included as part of the Six Areas of Contamination Source Area Feasibility Study completed in November 1997 (AFCEE 1997). The following three alternatives received a detailed analysis in the feasibility study:

- Alternative 1: No Action
- Alternative 4: Excavation/Asphalt Batching
- Alternative 5: Excavation/Off site Treatment and Disposal

B. Remedial Actions

This section presents the regulatory actions, RAOs, a description of the selected remedy, and a summary of the remedy implementation at AOC SD-2/FS-6/FS-8.

B.1. Regulatory Actions. Described below are the controlling documents that present the selected remedy and post-ROD documents that identified changes to the selected remedy.

Record of Decision: The *Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas* was finalized in September 1998 (AFCEE 1998) to document the decision to perform remedial actions a several AOCs including SD-2/FS-6/FS-8. The selected remedy documented in the ROD is Excavation/Asphalt Batching. This alternative provides institutional and engineering controls to limit exposure to site-related contaminants and to reduce source-area contaminant concentrations to protective levels. Confirmatory sampling after excavation would be conducted to ensure that all soil with COC concentrations exceeding RALs was removed. Excavated soil that is found to contain contaminant concentrations in exceedance of TCLP allowable concentrations would be deemed hazardous and disposed of off-site in a RCRA Subtitle C TSDF. Soil that is found to contain contaminant concentrations below TCLP allowable concentrations (and that has contaminant concentrations below MassDEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be deemed nonhazardous and treated at the on-site cold mix emulsion asphalt-batching plant.

Explanation of Significant Differences: The *Explanation of Significant Differences for Areas of Contamination CS-10 (A, B & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; SD-3/FTA-3/CY-4* was finalized in January 2003 (AFCEE 2003) to document changes to the selected remedy for several sites in the SARAP including SD-2/FS-6/FS-8. The modified remedy consisted of excavating contaminated surface soil at the AOC.

Excavated soil would be transported to on-base central bulking facility for waste characterization. Excavated soil that is found to have contaminant concentrations in exceedance of TCLP allowable concentrations would be deemed hazardous and disposed of off-site in a RCRA Subtitle C TSDF. Soil that is found to have contaminant concentrations below TCLP allowable concentrations (and that have contain contaminant concentrations below MassDEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be deemed nonhazardous and transported off-site to a Subtitle D facility.

B.2. Remedial Action Objectives. The RAOs are site-specific qualitative cleanup goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. Based on this comparison, the following RAO was established for AOC SD-2/FS-6/FS-8:

- Protect ecological receptors at AOC SD-2/FS-6/FS-8 from exposure to chromium, lead, and zinc in surface soil at concentrations exceeding STCLs and in the vicinity of sample locations SD-1 and SD-6 (AFCEE 1997).

The PRA completed at the AOC SD-2/FS-6/FS-8 identified potential risks to ecological receptors for the following COCs: chromium, lead, and zinc. MMR-specific STCLs used for the DSRP were retained and used to develop cleanup levels for identified contaminants of concern. In 2000, AFCEE with concurrence from EPA and MassDEP revised ecological risk based STCLs for inorganic chemicals in a Technical Memorandum (AFCEE 2000).

In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the technical memorandum (AFCEE 2002). The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. COCs and respective cleanup levels are presented in Table B-1.

Table B-1
COCs and RCLs for AOC SD-2/FS-6/FS-8 Source Areas

COC	Basis	RAL Concentration (mg/kg)
Chromium	Background	19
Lead	Ecological Risk	99
Zinc	Ecological Risk	68

B.3. Remedy Implementation.

Excavation and Disposal: AFCEE completed the remedial action in 2002 at AOC SD-2/FS-6/FS-8. Remedial activities and results of confirmatory sampling were documented in an RAR which was completed in June 2004 (AFCEE 2004). Approximately 350 cubic yards of contaminated soil was removed from the AOC. Confirmatory sampling results indicated that the contaminant concentrations in soil were below the RALs. Excavated soil was transported to a central bulking facility located on the MMR. Soil from AOC SD-2/FS-6/FS-8 was combined with soil from other sites. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. Soil from the AOC was disposed of at the North Carver Landfill in Massachusetts. Disposal activities were performed in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MassDEP 1997).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review:

- Final Remedial Action Report for SD-2/FS-6/FS-8: Completed in June 2004 (AFCEE 2004);

- AOC SD-2/FS-6/FS-8 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedial action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The remedial action has been completed and is functioning as intended by the ROD and modified by the ESD.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

<u>Changes in Standards and To-Be Considered</u>: Cleanup standards for the SD-2/FS-6/FS-8 remedial action were ecological risk-based. No cleanup standards have been promulgated based on ecological risk.

<u>Changes in Exposure Pathways</u>: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedial action.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: Ecological risk-based RALs for several inorganic constituents were calculated using toxicity information available in 2000 which are presented in a technical memorandum (AFCEE 2000). The SD-2/FS-6/FS-8 remedial action completed in 2002 was based on these ecological risk-

based RALs. No changes in toxicity and/or contaminant characteristics triggered the need to reevaluate ecological-risk based RALs.

Changes in Risk Assessment Methods: The remedial action was completed in 2002. There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the implemented remedial action.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the no further action for SD-2/FS-6/FS-8 Source (soil) based on current land use. A portion of this IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

A portion of this site is located outside the installation boundaries. Because, of the current land use of the site (i.e., storm drain), the selected decision remains protective in the short-term. See Section 3.4.2 for discussion on implementation of land-use controls for IRP sites located outside the installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The remedial action selected for SD-2/FS-6/FS-8 (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing COCs above ecological-risk based RALs have been removed. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1996 (December). *Final Remedial Investigation Report for the Runway/ Aircraft Maintenance Storm Drainage Ditch No. 2 (AOC SD-2/FS-6/FS-8).* Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

AFCEE. 2004 (June). *Final Storm Drain 2/Fuel Spill 6/Fuel Spill 8 SD-2/FS-6/FS-8 Remedial Action Report.* Prepared by Portage Environmental Inc. and Engineering Strategies Corporation for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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E.C. Jordan Co. 1990 (August). *Task 5 Mashpee Groundwater Study.* Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP, Portland, Maine.

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EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

MassDEP. 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection.

3.6.37 Storm Drain No. 3 (SD-3)/Fire Training Area No.3 (FTA-3)/ Coal Yard No. 4 (CY-4) Source

A. Background

A.1. Site Description. AOC SD-3/FTA-3/CY-4 is located near the southeastern border of MMR in a moderately industrialized area on the eastern side of the runways, covering approximately 30 acres. The majority of the AOC is bordered by Granville Avenue on the west and the ANG Ammunition Storage Area on the east (Figure 1-1). A small portion of SD-3 is located east of the ammunition storage area. The SD-3 stormwater drainage ditch receives runoff from this area and the eastern edge of the aircraft maintenance ramp, the former Central Heating Plant, and associated stockpiles of coal and surficial coal ash. Fire training activities reportedly occurred at FTA-3 between 1956 and 1958 following closure of FTA-2 in 1956 (E.C. Jordan Co. 1986). FTA-3 was located in an area where construction debris and coal ash were disposed of after construction of the Central Heating Plant in 1955.

CY-4 is located south of and parallel to Granville Avenue, approximately 400 feet south of the Central Heating Plant location. Coal was stockpiled directly on the ground at CY-4 from 1955 to 1978 and subsequently on a concrete pad. Coal ash was disposed of on the ground surface south of the coal stockpile. Surficial drainage from the coal-stockpile and ash-disposal areas is directed to the SD-3 drainage ditch. The Task 6 records search report indicated that relatively low concentrations of halogenated and non-halogenated solvents, fuel-related compounds, and coal-related compounds (e.g., PAHs and metals) might be present at AOC (E.C. Jordan Co. 1986).

A.2. Initial Response.

Soil Removal Action at FTA-3 and CY-4: Between February and April of 1994, the NGB, with concurrence of EPA and MassDEP, excavated coal, coal ash, and potentially contaminated soil from CY-4 and FTA-3 for use as subgrade fill during final capping of the main base landfill (LF-1). A total of 42,000 cubic yards of material, representing the

majority of coal and coal ash at CY-4, was excavated to depths of up to 15 ft bgs. Additionally, soil at the FTA-3 location, was also removed. This excavation was then backfilled with clean fill and covered with wood chips, restoring the land surface to approximately original grade. The excavation focused on the coal-stockpile and coal-ash disposal areas and did not encompass the entire surficial area identified during the RI program.

A.3. Basis for Taking Action. Environmental restoration at SD-3/FTA-3/CY-4 followed the CERCLA remedial action process. Provided below is a summary of investigations performed at AOC SD-3/FTA-3/CY-4.

<u>Field Investigations and Mashpee Groundwater Investigation</u>: The SD-3/FTA-3/CY-4 site has been investigated several times beginning with a records search in 1986. As part of the Mashpee groundwater study, a multilevel monitoring well cluster was installed downgradient of AOC SD-3/FTA-3/CY-4. These monitoring wells were sampled six times between May 1987 and February 1988. Results indicated that the AOC should be evaluated as a possible source of groundwater contamination (E.C. Jordan Co. 1990).

The SI program, conducted in the fall of 1987, included a storm drain inspection, a soil gas survey, excavation of 14 test pits, installation of seven soil borings with 21 soil samples, collection of one sediment sample, installation of five monitoring wells, collection of one surface water sample, and groundwater sampling. The SI also evaluated analytical data from six groundwater sampling rounds completed for the Mashpee groundwater study. Laboratory analyses of sediment and soil samples, storm drain effluent, and groundwater were for TCL VOCs, SVOCs, pesticides, PCBs (soil and sediment only), and TAL inorganics (E.C. Jordan Co. 1989).

<u>RI and Supplemental RI</u>: In 1989, a RI was performed to characterize the nature and extent of sediment, soil, and groundwater contamination at the AOC. Activities included six shallow test pits; two surface coal-ash samples; four storm drain sediment samples;

one upgradient monitoring well; four sediment samples with analyses for TCL VOCs, SVOCs, pesticides, PCBs, TAL inorganics, and TPH; 12 groundwater samples with analyses for TCL VOCs, lead, and TPH; and a leaching well liquid sample.

A limited supplemental RI was completed in 1993 to address concerns that additional VOC contamination may exist in the SD-3 drainage ditch and at the outfalls of two storm sewers south of the coal storage yard, which had not been previously sampled. The program consisted of collection of three sediment samples. One was collected from the SD-3 drainage ditch and analyzed for VOCs. The other two were collected from the discharge areas of the southern storm sewers and analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL inorganics (AFCEE 1996).

The RI report for AOC SD-3/FTA-3/CY-4 included a human-health PRA to evaluate potential human-health risks associated with exposure to contaminated surface soil and sediment using trespasser (child) and utility work exposure scenarios and an ecological PRA to evaluate potential ecological risks associated with exposure to contaminated surface soil (0-2 ft bgs) and sediment. The human health PRA calculated cancer risks for utility workers and child trespassers were below EPA and MassDEP target risk range. The conclusions of the ecological PRA were that additional remedial actions do not appear warranted.

<u>Feasibility Study</u>: Even though neither the human health nor ecological risk evaluations performed as part of RI indicated that risks were at unacceptable levels, AOC SD-3/ FTA-3/CY-4 was included as part of the Six Areas of Contamination Source Area Feasibility Study completed in November 1997 (AFCEE 1997). The feasibility study included the following two alternatives for SD-3/FTA-3/CY-4:

- Alternative 1: No action
- Alternative 2: Confirmation Sampling with Contingency of Excavation/Asphalt Batching

B. Remedial Action

This section presents the regulatory actions, RAOs, and a summary of the remedy implementation at AOC SD-3/FTA-3/CY-4.

B.1. Regulatory Actions. Described below are the controlling documents that present the selected remedy and post-ROD documents that identified changes to the selected remedy.

Record of Decision: The ROD for AOCs FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas finalized in September 1998 (AFCEE 1998) was prepared to document the decision to perform removal actions a several AOCs including SD-3/FTA-3/CY-4. The selected remedy documented in the ROD is Confirmation Sampling with Contingency of Excavation/Asphalt Batching. Confirmatory sampling after excavation would ensure that all soil with COC concentrations exceeding these cleanup levels was removed. Excavated soil that is found to have contaminant concentrations in exceedance of TCLP allowable concentrations would be deemed hazardous and disposed of off-site in a RCRA Subtitle C TSDF. Soil that is found to have contaminant concentrations below TCLP allowable concentrations (and that have contaminant concentrations below MassDEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be deemed nonhazardous and treated at the on-site cold mix emulsion asphalt-batching plant.

Explanation of Significant Differences: The ESD for AOCs CS-10 (A, B & E); CS-16/CS-17; FS-9; SD-2/FS-6/FS-8; SD-3/FTA-3/CY-4 finalized in January 2003 (AFCEE 2003) was prepared to document changes to the selected remedy for AOC SD-3/FTA-3/CY-4. The modified remedy consisted of excavating contaminated surface soil at the AOC. Excavated soil would be transported to on-base central bulking facility for waste characterization. Excavated soil that is determined to exceed TCLP allowable concentrations and therefore deemed hazardous would be disposed off-site in a RCRA

Subtitle C TSDF. Soil that is determined to be below TCLP allowable concentrations and therefore nonhazardous (and that are determined to contain contaminant concentrations below MassDEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling facility Summary Levels) would be transported offsite to a Subtitle D facility.

B.2. Remedial Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. Because response objectives were not identified for AOC SD-3/FTA-3/CY-4, RAOs were not developed. The ROD stipulated that soil sampling should be performed to confirm the adequacy of the 1994 removal action.

B.3. Remedy Implementation. No COCs were identified in the 6 AOC ROD for SD-3/FTA-3/CY-4. COCs were identified during the delineation sampling phase of the remedial action. Delineation soil samples were analyzed for PAHs and metals. Selection of COCs at SD-3/FTA-3/CY-4 for surface soil (0-2 ft bgs) were based on the comparison of analytical data with DSRP ecological risk-based STCLs for SVOCs and ESD ecological–risk based RALs for inorganic constituents. COCs identified during delineation sampling and respective cleanup levels are presented in Table B-1.

Table B-1
COC and RALs for AOC SD-3/FTA-3/CY-4 Source Areas

COC	Basis	RAL Concentration (mg/kg)
Phenanthrene	Ecological Risk	.0625
Chrysene	Ecological Risk	.0625
Arsenic	Background	7.1
Chromium	Background	19
Lead	Ecological Risk	99
Vanadium	Ecological Risk	47
Zinc	Ecological Risk	68

AFCEE completed the remedial action in 2002 at AOC SD-3/FTA-3/CY-4. Approximately 1,065 cubic yards of contaminated soil were removed from the AOC. Confirmatory sampling results indicated that the contaminant concentrations in soil were below the RALs. Excavated soil was transported to a central bulking facility located on the MMR. Soil from AOC SD-3/FTA-3/CY-4 was combined with soil from other sites. Composite sampling of the consolidated soil stockpiles determined that the consolidated soil was considered non-hazardous and suitable for reuse as daily cover at a RCRA Subtitle D Landfill. Soil from the AOC was disposed of at the Taunton Landfill in Massachusetts. Disposal activities were in compliance with the MassDEP *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy #COMM-97-001* (MassDEP 1997).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- Final Remedial Action Report for SD-3FTA-3/CY-4: Completed August 2004 (AFCEE 2004).
- AOC SD-3FTA-3/CY-4 was delisted as part of the partial deletion of sites from the Otis Air National Guard Base/Camp Edwards Superfund Site (see 72 FR 60786, October 27, 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedial action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

The remedy is functioning as intended by the ROD and ESD.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

<u>Changes in Standards and To-Be Considered</u>: Cleanup standards for the SD-3/ FTA-3/CY-4 remedial action were ecological risk-based. No cleanup standards have been promulgated based on ecological risk.

<u>Changes in Exposure Pathways</u>: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedial action.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: Ecological risk-based RALs for several inorganic constituents were calculated using toxicity information available in 2000 which are presented in a technical memorandum (AFCEE 2000). The SD-3/FTA-3/CY-4 remedial action completed in 2002 was based partly on these ecological risk-based RALs. No changes in toxicity and/or contaminant characteristics triggered the need to reevaluate ecological-risk based RALs.

<u>Changes in Risk Assessment Methods</u>: The remedial action was based on a comparison of delineation sampling results with DSRP ecological-risk based STCLs and calculated risk-based RALS (inorganics only) presented in the technical memorandum (AFCEE 2000) and established in the ESD (AFCEE 2003).

<u>Review of RAOs</u>: No RAOs were identified in the feasibility study or the ROD. The intent of the remedial action was to be protective of ecological receptors based on current and anticipated future land use. The implemented remedy is protective of ecological receptors.

Question C: Has any other information come into light that could call into question the protectiveness of the removal action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the no further action for SD-3/FTA-3/CY-4 Source (soil) based on current land use. Portions of this IRP site is located within installation boundaries and

exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The no further action is also protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

A portion of this site is located outside the installation boundaries. Because, of the current land use of the site (i.e., storm drain), the selected decision remains protective in the short-term. See Section 3.4.2 for discussion on implementation of land-use controls for IRP sites located outside the installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways). If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

G. Protectiveness Statement

The remedial action selected for SD-3/FTA-3/CY-4 (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. Soil containing COCs above ecological-risk based RALs have been removed. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

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3.6.38 Storm Drain No. 4 (SD-4) Source

A. Background

A.1. Site Description. AOC SD-4 is a wooded drainage basin located in the southeastern section of MMR which extends from the flightline security area immediately east of Hangar 124 approximately 3,500 feet south towards Johns Pond (Figure 1-1).

The drainage basin, which became operational in 1950, received stormwater drainage from storm sewers that lead from Hangars 158, 128, 126, and 124, including the buildings, runways, ramps, and decks that serve the four hangars in addition to the former Building 123 pump house area. The drainage basin also reportedly received flow from numerous spills and liquids disposal during daily operations at these facilities. In 1968, an OWS was constructed in the drainage basin south of Reilly Road.

The primary environmental concerns at AOC SD-4 were the effects of chemical releases on surface soil, subsurface soil, surface water, and groundwater. It was estimated that approximately 0.5 to 1.4 million gallons of petroleum distillate solvents was released to the SD-4 stormwater drainage system from Hangar 158. These solvents used in daily operations at support shops located in the hangar, were reportedly dumped into hangar deck drains connected to the storm drain system (ABB-ES 1992).

From 1955 to 1970, Hangar 128 was used to maintain 18 to 21 aircraft. During that time, known quantities of solvents were released into the storm drain system. From 1978 to 1988, the hangar was used by the USCG for aircraft maintenance. Periodic heating of the wing tanks of the aircraft resulted in numerous spills of AVGAS to the hangar deck; a portion of it was washed into the storm drain system. In 1978, a spill of approximately 1,000 gallons of AVGAS occurred outside the hangar; it was also flushed into the storm drain system. The nature and extent of these individual spills were also investigated as

part of the Site Investigation for CS-4 (USCG) and FS-1 (USCG), which are located northwest of AOC SD-4 (ABB-ES 1992).

A.2. Initial Response. The pump house at former Building 123 served four 25,000-gallon USTs that were used to store JP-4 jet fuel. The building and associated USTs were removed in April 1993 along with 70 cubic yards of contaminated soil (Metcalf & Eddy 1993). In addition, trenching was performed to expose and remove fuel lines leading to the jet fueling area. Screening results did not indicate the presence of fuel contaminated soil in fuel line trenches.

A.3. Basis for Taking Action. Environmental restoration at AOC SD-4 followed the CERCLA remedial action process. Provided below is a summary of investigations performed at AOC SD-4.

<u>Site Investigation:</u> The AOC SD-4 SI was conducted in two phases (Phases I and II) between 1989 and 1991 by ABB-ES (ABB-ES 1993). The SI included a soil gas survey, sediment sampling, excavation of test pits, and installation of monitoring wells. A sample of liquid and sediment in the gas trap associated with Building 123 was also collected.

<u>Remedial Investigation</u>: The RI included collecting surface soil samples at 14 locations (six of which were for SVOCs only), advancing five test borings, installing four new groundwater monitoring wells, collecting one round of groundwater samples from 11 monitoring wells, sediment sampling at nine locations, and surface water sampling at seven locations. Other data collected during the hydrogeologic investigation included depths to static groundwater, in-situ hydraulic conductivity test data on selected existing and newly installed monitoring wells, and performing grain-size distribution and total organic carbon analysis of sediment samples (CDM Federal Programs Corporation 1996).

Inorganic and organic contamination was detected in all media at SD-4. Three areas where contamination was of a concern included the drainage ditch north of Reilly Road;

the "upgradient" pond and associated wetlands, which is south of Reilly Road; and groundwater, which contained concentrations of organic and inorganic contaminants.

As part of the RI, a human-health PRA was performed based on future residential exposure scenarios for surface soil, groundwater, pond sediment, pond surface water, and wetland surface water. Subsurface soil was not evaluated. For surface soil, pond sediment, and wetland surface water; the calculated cancer risks for future residents were within the EPA target risk range and the calculated noncancer HI were below 1.0. For groundwater, the calculated cancer risks for future residents exceeded the EPA target risk range and the calculated noncancer HI of 1.0. The primary contributors to the calculated cancer risk were beryllium and arsenic. Both beryllium and arsenic concentrations were below their respective MCLs. The primary contributors to the calculated HI were both isomers of TMB and manganese. MCLs were not available for these constituents. For pond surface water, the human health PRA calculated cancer risks for future residents exceeded the EPA target risk range and the calculated noncancer HI of 1.0. The primary contributors to calculated cancer risks were carcinogenic PAHs, dieldrin, and Arochlor-1260. However, the calculated risks were considered conservative because of the following factors: (1) all detected PAHs were assumed to be AOC-related, (2) the use of conservative exposure assumptions, and (3) the use of oral slope factors to evaluate dermal risks.

The AOC SD-4 PRA evaluated potential ecological risks associated with exposure to contaminated surface soil (0 to 2 ft bgs), sediment, and surface water. Evaluations were made for exposure of various ecological receptors to the following media at AOC SD-4: surface soil; pond sediment and pond surface water; and wetlands sediment and wetlands surface water. The ecological risk -based COCs identified for sediments at AOC SD-4 included PAHs, VOCs, pesticides, PCBs, and metals. The ecological risk -based COCs identified for pond surface water at AOC SD-4 included PAHs, pesticides, Aroclor 1260, and metals. The results of the ecological PRA triggered the need for an evaluation of remedial alternatives (i.e., feasibility study).

Feasibility Study: AOC SD-4 was included as part of the Six Areas of Contamination Source Area FS completed in November 1997 (AFCEE 1997). The following alternatives received a detailed analysis in the feasibility study.

- Alternative 1: No Action
- Alternative 4: Excavation/Asphalt Batching
- Alternative 5: Excavation/Off site Treatment and Disposal

B. Remedial Actions

This section presents the regulatory actions, RAOs, a description of the selected remedy, and a summary of the remedy implementation at AOC SD-4.

B.1. Regulatory Actions. Described below is the controlling document that presents the selected remedy.

Record of Decision: The Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas finalized in September 1998 (AFCEE 1998) was prepared to document the decision to perform remedial actions a several AOCs including SD-4. The selected remedial alternative for the SD-4 source area was Alternative 4, Excavation/Asphalt Batching.

This alternative provides institutional and engineering controls for areas north of Reilly Road to limit exposure to site-related contaminants in soil and to reduce source-area contaminant concentrations to protective levels. Components of the remedy to address contamination north of Reilly Road included pre-excavation sampling to assess the horizontal and vertical distribution of contamination exceeding the TPH STCL and to identify areas of excavation.

For areas south of Reilly Road, this alternative provides for additional sampling and engineering controls to assess the contribution of sediment contaminants to surface water

contamination, the potential bioavailability and toxicity of pond sediments, and, if necessary, removal of source area sediments exceeding cleanup criteria (to be developed based on pre-excavation studies). The risk assessment did not identify the need to clean up groundwater at this AOC; consequently, the remedy did not include a management of migration component.

In the event that excavation of contaminated soil was warranted, confirmatory sampling after excavation would ensure that all soil with COC concentrations exceeding approved cleanup levels were removed. Excavated soil that is found to contain contaminant concentrations in exceedance of TCLP allowable concentrations would be deemed hazardous and disposed of off-site in a RCRA Subtitle C TSDF. Soil that has contaminant concentrations below TCLP allowable concentrations (and that were determined to contain contaminant concentrations below MassDEP MCP Method 1 S-1/GW-1 standards for pesticides and Massachusetts Permitted Soil Recycling Facility Summary Levels) would be deemed nonhazardous and treated at the on-site cold mix emulsion asphalt-batching plant.

B.2. Remedial Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. The following RAOs were established for AOC SD-4:

- Prevent human and ecological exposure to shallow (0 to 2 ft bgs) drainageway soil and sediment contaminated with TPH exceeding 500 parts per million (ppm).
- Manage pond sediments to prevent surface water contamination which present potential risks to human receptors exceeding the EPA cancer risk management range.
- Manage pond sediments to prevent surface water contamination at concentrations exceeding chronic ambient water quality criteria.

Cleanup levels are the site-specific quantitative values that will achieve RAOs. For the area designated as SD- 4 north of Reilly Road, the inside-the-flightline TPH STCL (1,200 mg/kg) was chosen as the cleanup level. No cleanup levels were developed for sediment or surface water when the ROD was finalized.

B. Remedy Implementation.

Pre-Excavation Sampling (North of Reilly Road): In August 1999, soil sampling was conducted in the drainage ditch north of Reilly Road to confirm the presence or absence of TPH contamination in soils at levels above STCLs. Surface soil samples (0-1 ft bgs) were collected at three locations; and soil samples were collected from 2.5-3 ft bgs at all six locations. All samples were analyzed for EPH/VPH. The analytical results from Detail A indicated no EPH/VPH exceedances of 1996 STCLs in the drainage ditch (TN&A 2000). As a result, no action was required for the drainage ditch north of Reilly Road.

Ecological Evaluation of the AOC SD-4 Site (Surface Water and Sediment): Pre-excavation studies at the AOC pond focused on surface water quality, on the bioavailability of inorganic contaminants, and on evaluation of pond/wetland structure and productivity to assess whether adverse effects are actually occurring and whether sediment remediation was justified (AFCEE 2002). The risk characterization indicated no or minimal adverse environmental impacts to indicator species at SD-4. It was recommended that the sediments in the SD-4 pond remain undisturbed.

Ecological Evaluation of the AOC SD-4 Site (Wetland Hydric Soil): Because metals were detected in surface soil adjacent to the pond, additional ecological risk evaluation was planned to determine if any soil removal was needed. The ERA included several components to assess the need to perform remedial action for SD-4 soil. Key components of the ERA included: revising the list of ecological COCs based on 2001 and 2003 sampling data, (2) completing of food chain analysis for terrestrial vertebrates, and (3) conducting toxicity tests for invertebrates and wetland plants. All analyses were performed following EPA Region I and MassDEP guidance. Updated toxicity values and exposure assumptions were used for calculations. The conclusions of the post-ROD ecological risk evaluation were that no further action was required for SD-4 hydric soil to be protective of ecological receptors. The ecological risk evaluation was documented in the *Final Revised Screening Level Risk Assessment* (AFCEE 2003a) and the *Final Ecological Risk Assessment Addendum* (AFCEE 2003b).

C. Progress Since the Last Five-Year Review

The following activities were conducted since the last review.

- Ecological Evaluation of the AOC SD-4 Site (Wetland Hydric Soil) (AFCEE 2003a), AFCEE 2003b): Completed in 2003.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the removal action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy/removal action functioning as intended by the decision documents?

Results of the post-ROD petroleum hydrocarbon sampling conducted at the drainage ditch north of the Reilly Road indicated that no action was necessary for the protection of human health or ecological receptors for this area designated as part of SD-4. The post-ROD ecological evaluation for the pond and associated wetland using 2001 and 2003 data, updated toxicity and exposure assumption information, and results of site-specific toxicity tests indicated that no action was necessary for the protection of ecological receptors. Pre-excavation sampling and evaluation of data was a component of the selected remedy, therefore, the remedy is functioning as intended by the ROD.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: AFCEE performed an ERA in 2002 and 2003 based on updated EPA Region I and MassDEP risk assessment guidance. No COCs were selected and therefore, no action for the protection of ecological receptors was required based on the post-ROD ecological risk evaluation.

Petroleum hydrocarbons were of concern in the drainage ditch north of Reilly Road. The post-ROD delineation sampling results showed very little contamination (below MassDEP S-1/GW-1 standards). As a result, no action was required. MassDEP has promulgated new S-1/GW-1 standards in 2008, however the new standards do not impact the Post-ROD no action decision.

Changes in Exposure Pathways: There have been no changes in the physical conditions and exposure pathways at the site that would affect the protectiveness of the no further action decision based on the post-ROD risk analysis and sampling results.

Changes in Toxicity and Other Contaminant Characteristics: There were changes in the toxicity factors for contaminants of concern and they were taken into account for the preparation of the post-ROD ecological risk evaluation.

Changes in Risk Assessment Methods: AFCEE performed a Post-ROD ecological risk evaluation based on updated EPA Region I and MassDEP guidance.

Review of RAOs: There is no RAO for groundwater. As indicated below in Section E, an evaluation of groundwater could require a new RAO.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the no further action for SD-4 Source (soil) based on current land use. Portions of this IRP site is located within installation boundaries and exposure pathways for humans are currently controlled or mitigated by DoD and/or USGS land use and management practices. The no further action is also protective of ecological receptors. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

A portion of this site is located outside the installation boundaries. Because, of the current land use of the site (i.e., storm drain), the selected decision remains protective.

See Section 3.4.2 for discussion on implementation of land-use controls for IRP sites located outside the installation boundaries.

The calculated noncancer HI for groundwater (from the RI PRA), which is based on residential exposure scenarios, exceeded the EPA threshold of 1.0. Primary contributors include isomers of TMB. At the time of the RI, no action was recommended because no MCLs existed for TMBs. TMBs however, are classified and regulated by the MassDEP as C_{11}-C_{22} aromatic hydrocarbons.

For any exposure pathway (e.g., subsurface soil) within the source area where hazardous substances, pollutants, or contaminants remain or may remain above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness.

E. Issues

(1) However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or enforceable land use controls may be necessary to ensure long-term protectiveness.

(2) The calculated noncancer HI for groundwater, which is based on residential exposure scenarios, exceeded the EPA threshold of 1.0 and the ROD does not include a RAO regarding groundwater nor does the remedy include a land use control preventing residential exposure for this area of groundwater.

F. Recommendations and Follow-Up Actions

(1) Conduct a reassessment of site data and current standards to determine if, based on future residential exposure, an unacceptable risk remains. In some cases, this may lead to the need to collect additional samples and/or conduct a risk assessment based on future residential exposure (using up-to-date toxicity data and exposure pathways).

If this reassessment indicates that the site may still pose an unacceptable risk, then either (1) conduct additional cleanup to levels that allow for unlimited use and unrestricted exposure, or (2) issue a decision document implementing enforceable institutional controls preventing uses for which the site may still pose an unacceptable risk.

(2) An RAR will be prepared to document all post-ROD actions.

(3) An ESD will be prepared to document all changes to the remedy.

(4) Groundwater needs to be re-evaluated to determine if an additional RAO and subsequent land use controls are required for the SD-4 area.

G. Protectiveness Statement

The no further action decision based on Post-ROD sampling and ecological risk analyses selected for SD-4 currently protects human health and the environment because contaminant levels in soil are below cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

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3.6.39 Storm Drain No. 5 (SD-5)/Fuel Spill No. 5 (FS-5) Source

A. Background

A.1. Site Description. AOC SD-5/FS-5 is located in the central part of the MMR cantonment area between North Inner Road and Lingley Avenue on the north and south, respectively, and Base Runway No. 5 on the east, approximately 3,000 feet from the southern MMR boundary (Figure 1-1). The AOC occupies approximately 40 acres at the northern end of a natural drainage swale that formerly extended southward for more than 10,000 feet toward Ashumet Pond.

The central drainage swale at AOC SD-5/FS-5 receives stormwater runoff from approximately 100 acres of paved runways and ramps through an extensive stormwater drainage system. The swale is unlined and water that does not evaporate or infiltrate, flows south to an unlined 1-acre stormwater infiltration basin.

In the 1950's, the storm drainage swale received runoff from a number of sources including the Eastern and Western Aquafarms, the Non-Destructive Inspection Laboratory (NDIL), and the Corrosion Control Shop. Between 1994 and 1996, many of these structures were removed or demolished including: NDIL, NDIL leaching well, Corrosion Control Shop, six 25,000-gallon USTs at the Western Aquafarm, four 25,000-gallon tanks at the Eastern Aquafarm, and seven 550-gallon tanks associated with water separator control pits.

In the early 1960's, three refueling aircraft were destroyed in a fire, resulting in the FS-5 fuel spill of up to 15,000 gallons of (AVGAS). The spill was washed into the storm drain.

For site management purposes, in October 2000, the CS-2 drainage swale was grouped with SD-5/FS-5. The CS-2 drainage swale received stormwater from motor pool pavements and from a historic stormwater drainage system for East Outer Road. The

drainage swale was approximately eight feet wide, three feet deep, and 150 feet long. It emptied out into a grassy plain that is considered a part of the SD-5/FS-5 AOC.

A.2. Initial Response.

Aqua Fuel Farm Tank Removal: Seventeen USTs were removed from the Eastern Aquafarm, Western Aquafarm, water separator control pits, and AVLUBE area, at or near SD-5. Each tank was clean closed in conformance with all applicable Commonwealth of Massachusetts regulations as documented in the closure report entitled *Closure Report Aqua Fuel Farm Tank Removal & Site Restoration Otis Air National Guard Base* dated August 1995 (Environic Solutions Inc. 1995).

Drainage Structure Removal Program: Drainage structures 28CDXX1, 28CDXX2, 28CDXX3 and 28CDXX4 were excavated and removed from SD-5A in 1996 as part of the DSRP. These removals are documented in the report entitled *Drainage Structure Removal Program Remedial Action Summary Report* dated January 1999 (HLA 1999).

A.3. Basis for Taking Action. Environmental restoration at AOC SD-5/FS-5 followed the CERCLA remedial action process. Provided below is a summary of investigations performed at AOC SD-5/FS-5.

Preliminary Assessment: As part of the PA conducted in 1986 for the IRP at MMR, AOC SD-5/FS-5 was identified as a potential site of past uncontrolled disposal of hazardous substances (E.C. Jordan Co. 1986).

Site Investigation: An SI was conducted in 1988 to further characterize the distribution of soil and groundwater contamination at suspected source locations. Results of these investigations (E.C. Jordan Co. 1989 and 1990) identified ungrouted joints in drainage pipes, which may have allowed water to pass into and out of the drainage pipes. Soil sampling results from test pits in the Central Drainage Swale indicated that PAHs and

lead were present. During monitoring well installation, sampling results confirmed that the NDIL leaching well was a source of both soil and groundwater contamination.

Remedial Investigation: The RI for AOC SD-5/FS-5 was completed in 1996 (ABB-ES 1996). AOC SD-5/FS-5 was divided into three SOUs as follows:

- SD-5A: NDIL and Corrosion Control Shop;
- SD-5 B: Western Aquafarm, AVLUBE Barrel Storage Area, and Refueler Truck Park Area;
- SD-5 C: Eastern Aquafarm, Permanent Field Training Site, FS-5, and Central Drainage Swale.

SD-5A: The RI soil characterization program at SD-5A included ground-penetrating radar (GPR), test pits, and surface soil sampling. Surface soil in the vicinity of the Corrosion Control Shop was contaminated with inorganics, PAHs, and TPH. The NDIL leaching well and the Corrosion Control Shop were point sources of solvent contaminants. Groundwater samples collected in the vicinity of the NDIL confirmed impact to groundwater.

SD-5B: The RI soil characterization program at SD-5B included GPR, test pits, subsurface soil sampling, and surface soil sampling. Chromium, lead, zinc, and petroleum hydrocarbons were detected in surface soil at the Refueler Truck Park Area.

SD-5C: The RI soil characterization program at SD-5C included surface soil sampling and subsurface soil sampling. The central drainage swale contained inorganics in surface soil. The contamination did not appear to be uniformly distributed across the drainage ditch but concentrated at the outfalls.

The RI included a human-health PRA to evaluate potential human-health risks associated with exposure to contaminated surface and subsurface soil under an occupational (worker) exposure scenario. The calculated cancer risk was within the EPA acceptable

risk range and the calculated noncancer hazard index was below one. Although lead and TPH were not quantitatively evaluated in the PRA; they exceeded MassDEP soil standards, and were therefore considered human health COCs. An ecological PRA was also completed. The ecological risk-based COCs identified at AOC SF-5/FS-5 were chromium, copper, cyanide, lead, mercury, and zinc. Impact to groundwater was also evaluated. Benzene and TCE were identified as COCs based on potential impact to groundwater.

<u>Feasibility Study</u>: A feasibility study was finalized in November 1997 (AFCEE 1997). Major components of the feasibility study included development of response actions, RAOs, cleanup levels, and remedial action alternatives.

The feasibility study included identification and screening of technologies, development and screening of alternatives, and selection and detailed analysis of alternatives to address contamination at SD-5/FS-5. Alternatives that received analysis are listed below:

- Alternative One: No Action
- Alternative Two: Limited Action
- Alternative Three: Excavation and Asphalt Batching
- Alternative Four: Excavation/Off-site Treatment and Disposal

B. Remedial Actions

This section presents the regulatory actions, RAOs, a description of the selected remedy, and a summary of the remedy implementation at AOC SD-5/FS-5.

B.1. Regulatory Actions. Described below are the controlling documents that present the selected remedy and post-ROD documents that identified changes to the selected remedy.

<u>Record of Decision</u>: The *Record of Decision for Areas of Contamination FTA-2/LF-2, PFSA/FS-10/FS-11, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, and SD-5/FS-5 Source Areas*

was finalized in September 1998 (AFCEE 1998) to document the decision to perform a remedial action at SD-5/FS-5. The selected remedial alternative for AOC SD-5/FS-5 was Excavation/Asphalt Batching. Major components of the selected remedy included: (1) delineation sampling , (2) excavating soil exceeding cleanup criteria, (3) transporting soil to the onsite asphalt-batching facility or off-site TSDF based on waste characterization, (4) backfilling excavation, (5) maintaining institutional controls that restrict site access and limit potential human exposure to contaminants, and (6) performing five-year reviews.

Explanation of Significant Differences: An ESD was prepared in 2000 to remove the drainage swale from the CS-2 AOC and add it to AOC SD-5/FS-5. An estimated 100 cubic yards of soil was expected to be removed.

B.2. Remedial Action Objectives. The RAOs are site specific qualitative cleanup goals that must be achieved to meet remedial response objectives. The RALs are the site-specific quantitative cleanup levels that will meet these goals. The PRA completed at the AOC SD-5/FS-5 identified potential risks to receptors for the following COCs: chromium, copper, lead, mercury, zinc, cyanide, benzene, TCE, and TPH. MMR-specific STCLs used for the DSRP were retained and used to develop cleanup levels for identified contaminants of concern. In 2000, AFCEE with concurrence from EPA and MassDEP revised ecological risk-based STCLs for inorganic chemicals in a technical memorandum (AFCEE 2000).

In 2002, AFCEE revised phytotoxicity and invertebrate STCLs for several inorganics in an addendum to the technical memorandum (AFCEE 2002). The revised STCLs led to the development of RALs, which also took into account terrestrial plant screening levels, terrestrial invertebrate screening levels, and MMR-specific background levels. Development and establishment of RALs will be documented in another ESD to be prepared at a future date. Furthermore, this ESD will document the establishment of MassDEP Method S-1/GW-1 EPH/VPH cleanup standards as RALs in instances where

TPH were considered COCs. COCs and respective cleanup levels are presented in Table B-1 and Table B-2. Specifically, the RAOs established for AOC SD-5/FS-5 are:

- Protect potential human receptors from exposure to unacceptable concentrations of TPH and lead in surface soil,
- Protect ecological receptors from unacceptable risk resulting from exposure to surface soil, and
- Prevent organic compounds in soil from being a source of groundwater contamination.

Table B-1
COCs and RCLs for AOC SD-5/FS-5 Source Areas

COC	Basis	Concentration (mg/kg)
Chromium	Background	19
Copper	Ecological Risk	61
Lead	Ecological/Human Risk	99
Mercury	Ecological Risk	18
Zinc	Ecological Risk	68
Cyanide	Background	1
Benzene	Leaching Potential	0.1
TCE	Leaching Potential	0.01
TPH	MCP S-1/GW-1 Standards	See Table B-2

Table B-2
MCP S-1/GW-1 Standards for Petroleum Hydrocarbons (pre-2008)*

Type of Petroleum Hydrocarbons	Basis	RAL (mg/kg)
Aliphatic Hydrocarbons		
C_5 through C_8 Aliphatic Hydrocarbons	Human Health	100
C_9 through C_{12} Aliphatic Hydrocarbons	Human Health	1,000
C_9 through C_{18} Aliphatic Hydrocarbons	Human Health	1,000
C_{19} through C_{36} Aliphatic Hydrocarbons	Human Health	2,500

Table B-2
MCP S-1/GW-1 Standards for Petroleum Hydrocarbons (pre-2008)*

Type of Petroleum Hydrocarbons	Basis	RAL (mg/kg)
Aromatic Hydrocarbons		
C_9 through C_{10} Aromatic Hydrocarbons	Human Health	100
C_{11} through C_{22} Aromatic Hydrocarbons	Human Health	200

*Note: MassDEP has promulgated new S-1/GW-1 and S-3/GW-1 standards since the remedial action was performed. The RAR for SD-5/FS-5 has yet to be finalized and will compare remedial action confirmation samples with new standards.

B.3. Remedy Implementation. Provided below are summaries of excavation activities at AOC SD-5/FS-5. Several changes and additions were made to the selected remedy and will be included in an ESD (i.e., operation of an AS/SVE) system, deletion of the asphalt batching component of the original remedy, off-site disposal of excavated soil, and new RALs. Remedial Actions performed at AOC SD-5/FS-5 are documented in a Draft SD-5/FS-5 RAR (AFCEE 2005).

SD-5A (AS/SVE System): Benzene and TCE were present at concentrations exceeding the ROD cleanup levels at various depths at SD-5A. The SVE system for remediation of the LF-2/FTA-2 site was modified and used to remove VOC contamination. The SVE system operated from August 2002 through August 2003. Modeling of the impact of VOC concentrations in soil to groundwater was conducted to shutdown the AS/SVE system. During a site inspection conducted on September 7, 2004, MassDEP and AFCEE personnel observed an area of dark colored loose granular material, approximately one-foot thick. AFCEE performed a removal of this material in December 2004.

SD-5B (Excavation): Approximately 912 cubic yards of inorganic and petroleum-contaminated soil were excavated from SD-5B. During a site inspection held on September 7, 2004, MassDEP and AFCEE personnel observed clumps of weathered residual oil stained soil inside the fence line. This area had previously been occupied by

pallets of old metal equipment and wood covered with tarps. In December 2004, AFCEE removed the shallow soil along and inside the fence line.

SD-5C (Excavation): Excavation at SD-5C was performed as a result of inorganic COC concentrations exceeding ecological risk-based cleanup levels. Approximately 1,260 cubic yards of soil at SD-5C was excavated.

FS-5 Excavation: Excavation at FS-5 was performed as a result of inorganic COC concentrations exceeding ecological risk-based cleanup levels. Approximately 116 cubic yards of soil was excavated to an average depth of 2 ft bgs.

Former CS-2 Drainage Swale: The drainage swale excavation was primarily based on topography and historical sample results. Approximately 61 cubic yards of soil was excavated to an average depth of 2 ft bgs. An additional 13 cubic yards of soil and approximately 100 concrete blocks lining the ditch were excavated to a total depth of 5 ft bgs in some locations. A total of approximately 74 cubic yards of soil was excavated. The concrete blocks were transported to the Central Staging Area (CSA) and were decontaminated, reduced and disposed of offsite.

Excavated soil from AOC SD-5/FS-5 were transported to the CSA and combined with soil from other excavations that were part of the SARAP. Soil samples were collected at a frequency of one sample per 500 tons, and were analyzed for the parameters regulated in the *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills, DEP Policy # COMM-97-001* (MassDEP 1997). The stockpiled soil was shipped as a non-hazardous material under a MassDEP Bill of Lading, to the Taunton Landfill in Taunton Massachusetts and the Thatcher Street Landfill in Brockton Massachusetts.

C. Progress Since the Last Five-Year Review

The following activity was conducted since the last review.

- Draft Remedial Action Report for SD-5/FS-5: Completed in September 2005 (AFCEE 2005).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedial action. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

The remedial action has been completed as intended by the ROD. However, there were several changes to the selected remedy and these changes will be documented in an ESD at a later date.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the removal action selection still valid?

Changes in Standards and To-Be Considered: TPHs which were the COCs identified in the ROD was divided into aromatic and aliphatic classes of petroleum compounds (i.e., EPH/VPH). MassDEP S-1/GW-1 standards were used for cleanup standards. MassDEP has re-evaluated S-1/GW-1 standards since the last five-year review. The new S-1/GW-1 standards became effective on February 14, 2008 [see 310 CMR 40.0975(6) (a)]. The MassDEP S-1/GW-1 standard for C_{19} through C_{36} aliphatic hydrocarbons has increased from 2,500 mg/kg to 3,000 mg/kg. The MassDEP S-1/GW-1 standard for C_{11} through C_{22} aromatic hydrocarbons has increased from 200 mg/kg to 1,000 mg/kg. The new MassDEP S-1/GW-1 standards do not change the protectiveness of the remedial action performed in 2005.

Changes in Exposure Pathways: There have been no changes in the physical conditions, exposure pathways, and land use of the site that would affect the protectiveness of the remedial action.

Changes in Toxicity and Other Contaminant Characteristics: Ecological risk-based RALs for several inorganic constituents were calculated using toxicity information available in 2000 which are presented in a technical memorandum (AFCEE 2000). The SD-5/ FS-5 remedial action completed in 2005 was partly based on these ecological risk-based RALs. No changes in toxicity and/or contaminant characteristics triggered the need to reevaluate ecological risk-based RALs. MassDEP has re-evaluated S-1/GW-1 standards for EPH/VPH since the last five-year review. The MassDEP S-1/GW-1 standards are based on unrestricted use and take into consideration dermal exposure, ingestion exposure, and impact to groundwater. For several classes of petroleum compounds (EPH/VPH); the new MassDEP soil standards promulgated in 2008 are less stringent than the MassDEP soil standards used at the time of the remedial action.

Changes in Risk Assessment Methods: There are no changes in risk assessment methodologies (human health and ecological) that have triggered the need to evaluate the validity of the implemented remedial action.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedial action?

There is no other information at this time that calls in the question of the *short-term* protectiveness of the remedial action based on current land use (i.e., DoD and/or USCG). This IRP site is located within installation boundaries and exposure pathways for humans are *currently* controlled or mitigated by DoD and/or USCG land use and management practices. The implemented remedial action is protective of ecological receptors. However, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, additional cleanup and/or

enforceable land use controls may be necessary to ensure long-term protectiveness. See Section 3.4.1 for discussion on implementation of land-use controls for IRP sites located within installation boundaries.

E. Issues

As noted above, hazardous substances, pollutants, or contaminants may remain at the site above levels that allow for unlimited use and unrestricted exposure, and the site lacks enforceable land use controls.

F. Recommendations and Follow-Up Actions

Recommendation: Finalize the RAR which should include a comparison of COCs with new MassDEP standards (if applicable). Furthermore, prepare an ESD to document changes to the remedy documented in the ROD. Land-use restriction/control requirements are yet to be determined based on excavations, operation of the AS/SVE treatment system, delineation sampling, and confirmation sampling conducted as part of the remedial action and should be evaluated prior to the submittal of the RAR and ESD.

Follow-Up Actions: Finalize RAR and complete the ESD.

G. Protectiveness Statement

The remedial action completed for SD-5/FS-5 (source control including excavation and off-site disposal) currently protects human health and the environment because the removal actions achieved cleanup levels that are protective of human health under current land use exposure scenarios. However, in order for the remedy to be protective in the long-term, the recommendations and follow-up actions specified in Section F of this sub section need to be taken to ensure long-term protectiveness.

H. References

ABB-ES. 1996 (December). *Final Remedial Investigation Stormwater Drainage Ditch No. 5 (SD-5) Including Fuel Spill No. 5 (FS-5)"*; Installation Restoration Program; Massachusetts Military Reservation. Prepared for HAZWRAP; Portland, Maine.

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MassDEP. 1997. *Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy # COMM-97-001*, Massachusetts Department of Environmental Protection.

4.0 GROUNDWATER SITES REQUIRING FIVE-YEAR REVIEW

This section presents groundwater sites for which a five-year review is required. Sixteen sites required a five-year review because of one of the following conditions:

- remedy or no further action decision was completed within the five-year timeframe (i.e., 2002-2007);
- remedy has not been completed; or
- the site is under investigation.

The following sections present several topics which are relevant to every groundwater site, vapor intrusion (VI), sustainability and land use controls. Table 4-1 presents groundwater sites that are part of this five-year review.

4.1 VAPOR INTRUSION

VI has drawn more attention over the last few years as a potential exposure pathway of concern in the investigation and remediation of contaminated sites. VI is defined as the migration of volatile chemicals from the subsurface into overlying buildings (ITRC 2007, EPA 2002). The presence of VOCs in soil or groundwater offers the potential for chemical vapors to migrate through subsurface vadose zone soils and along preferential pathways (such as underground utility lines or cracks in foundations) potentially impacting the indoor air quality of affected buildings and structures.

The VI pathway has been considered both qualitatively and quantitatively in the past in some of the CERCLA risk assessments prepared for the IRP plumes by AFCEE. However, due to the more recent increased regulatory focus on the VI pathway and the advances in the understanding of the science of VI, the potential for VI will be re-assessed for each of the IRP groundwater sites at MMR. This re-assessment will initially involve determining whether there is a complete VI exposure pathway for each groundwater site. If a complete exposure pathway is identified, a preliminary screening step will be completed which will involve developing a VI conceptual site model, assess

available site data, and compare site data to generic published screening levels. The results of this screening step will determine whether no further action is needed or whether further investigation and/or mitigation is required. The VI evaluation approach will follow the most current Federal and/or State technical guidance at the time the evaluation is performed.

REFERENCES

EPA. 2002. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils.* Washington, D.C.: Office of Solid Waste and Emergency Response. www.epa.gov/correctiveaction/eis/vapor/complete.pdf.

ITRC (Interstate Technology & Regulatory Council). 2007. *Vapor Intrusion Pathway: A Practical Guideline*. VI-1. Washington, D.C.: Interstate Technology & Regulatory Council, Vapor Intrusion Team. www.itrcweb.org.

4.2 SUSTAINABILITY

In a world that is resource limited and increasingly aware of activities that could impact global climate, there is growing emphasis on designing and maintaining more sustainable, low-impact engineering solutions. This emphasis on sustainability extends to the remediation of soil and groundwater. AFCEE is committed to a more complete evaluation of sustainability metrics when considering and comparing the total impacts, benefits, and life-cycle costs of environmental remediation alternatives.

Similarly, as outlined in the EPA's Technology Innovation Program's CLU-IN website, the EPA is committed to developing and promoting innovative cleanup strategies that restore contaminated sites to productive use, reduce costs, and promote environmental stewardship, while ensuring that cleanups are protective of human health and the environment. In accordance with EPA's strategic plan for compliance and environmental stewardship, the Agency strives for cleanup programs that use natural resources and energy efficiently, reduce negative impacts on the environment, minimize pollution at its source, and reduce waste to the greatest extent possible. EPA supports the adoption of **green remediation as the practice of considering all environmental effects of cleanup actions and incorporating strategies to maximize the net environmental benefit.**

Green remediation results in effective cleanups minimizing the environmental and energy "footprints" of site remediation and reuse. Sustainable practices emphasize the need to more closely evaluate core elements of a cleanup project:

- Energy requirements of the treatment system,
- Air emissions,
- Water requirements and associated impacts on water resources,
- Impacts on land and ecosystems,
- Material consumption and waste generation, and
- Long-term stewardship actions.

To this end, this five-year review recommends adoption of a strategy that more fully encompasses all environmental effects of cleanup actions (to a reasonable degree) when evaluating groundwater system operations and optimizations in order to more holistically address protectiveness. AFCEE has developed a sustainability assessment tool that was presented as an appendix in the *Draft Supplement to the Chemical Spill-10 Groundwater Feasibility Study Addendum* dated April 2008. This tool should be built upon and improved and used as a template for integrating sustainability into remediation decisions at the MMR. EPA encourages green remediation practices but EPA has not endorsed or concurred with AFCEE's sustainability assessment tool or its use in CERCLA decision making.

4.3 LAND USE CONTROLS

Each of the groundwater sites assessed in Section 4.4, except for CS-19, Eastern Briarwood, FS-13, and Western Aquafarm, are located partially or entirely outside the boundaries of the Massachusetts Military Reservation (Figure 1-1). These off-base groundwater plume areas are located in four different towns: Bourne, Sandwich, Mashpee, and Falmouth. Additionally, some groundwater plumes are located in more than one town.

The Air Force, EPA, and MassDEP have coordinated with the four towns in past years to develop town-specific groundwater use regulations issued through the towns' respective Boards of Health. Additionally, the Air Force has provided municipal water service and/or household connections to homes in the areas of the groundwater plumes that were previously service with private wells. During the development of the RODs for CS-23 and LF-1 in the summer of 2007, the Air Force and the regulatory agencies agreed that the Boards of Health (BOH) regulations and ancillary enforcement procedures were not adequate to ensure the prevention of potential exposure to contaminated groundwater from the MMR plumes. Examples of potential exposure include: residents using former private drinking wells for irrigation, filling of swimming pools, or car washing; parcels with more than one home using a combination of private wells and municipal water supply; or residents that declined earlier offers from the Air Force for connection to a municipal water supply.

As a result of these discussions, the LF-1 and CS-23 RODs contain specific procedures that require the Air Force to verify the private well status of all parcels within the plume footprints. The well verification requirements (modified to read generically for all off-base MMR plumes) follow:

Within three years of the signing of the ROD or ESD, the Air Force shall:

a. Document all private wells (i.e., non-decommissioned wells, including wells not currently in use) that are above or within the projected path of the plume(s).

b. Demonstrate and document that the private well is not capable of drawing contaminated groundwater originating from the plume(s), or test the private well for contamination and demonstrate the private well to be safe for human use. The Air Force will continue such testing, on an appropriate frequency as determined in coordination with the EPA, until the plume(s) no longer presents a threat to that well as determined in coordination with EPA.

c. If the Air Force identifies a well containing COCs, the Air Force shall assess the risk that current and potential future non-drinking uses of the well may pose to human health. The Air Force shall submit a draft version of any such risk assessment to EPA for review and concurrence.

d. If neither b nor c is able to confirm that the identified well is safe for human use, the Air Force will offer the owner decommissioning of the well. If accepted, the Air Force will document such action with the appropriate BOH. If the decommissioning is not accepted, the Air Force will take other steps to insure protectiveness to include, but not be limited to, requesting assistance from the appropriate BOH to issue health warnings to the property owner and any other person with access to the well (such as a lessee or licensee), offering bottled water (if well is used for drinking), or installing treatment systems on affected wells. In each instance, the Air Force shall submit a schedule subject to EPA concurrence, outlining and including time limitations for the completion of steps sufficient to prevent exposure to concentrations of contaminated groundwater from the plume(s) having carcinogens in excess of ARARs (i.e., MCLs, non-zero MCL goals), and prevent exposure to groundwater from the plume(s) that poses a cancer risk in excess of the EPA target risk range of 10^{-4} to 10^{-6} or which presents a non-carcinogenic hazard index greater than one.

The Air Force has developed a guideline for implementing this requirement titled *Verification, Decommissioning, and Documentation Guidelines for Private Wells in Areas of Potential Concern* dated May 2008. Additionally, the Air Force developed and is using a LUC database to record the status of the well verification process and subsequent results for the over 1,500 parcels located in plume areas. The database is capable of producing a variety of reports and is being shared with the regulatory agencies. As of the summer of 2008, the Air Force had queried over 500 parcels located in the Ashumet Valley (AV) plume area and prepared parcel lists for the CS-4, CS-20, CS-21, FS-28, and FS-29 in preparation for an initial query.

This five-year review has determined that the remedies in place for groundwater sites are protective in the short term since there is no evidence that there is current, unacceptable exposure to contaminated groundwater. However, in order to ensure long term protectiveness, all groundwater sites with off-base plume areas must undergo the well verification process described above. It is recommended that this requirement be codified in an ESDs for those off-base groundwater sites with RODs that do not currently contain the well verification language as part of the required LUCs. For off-base groundwater sites without final RODs (AV and CS-10), the well verification language needs to be included in the LUC requirements when the RODs are prepared, which is anticipated to be in 2009.

4.4 GROUNDWATER SITE WRITE-UPS

4.4.1 Ashumet Valley (AV) Groundwater

A. Background

A.1. Site Description. The AV plume (Figure 4-1) is the result of leaching of chlorinated VOCs from the former fire training area (FTA-1). This plume co-mingles with sewage-related groundwater contaminants (primarily phosphorous and nitrogen) from the MMR STP disposal beds (CS-16). As a result of biological activity in the sewage plume, reducing conditions have increased the solubility (and thus the concentration) of some metals (e.g., manganese and iron) in AV groundwater.

The AV plume is one of the seven groundwater plumes included in the Interim Record of Decision (IROD) (ANG 1995), and is currently undergoing the IROD to Final ROD process. The COCs for the AV plume were established in the final feasibility study and are PCE, TCE, thallium, and manganese (AFCEE 2007c). The AV interim remedial system was installed and started operation in 1999. It is comprised of an extraction, treatment, and infiltration (ETI) system that is designed to remediate a portion of the AV PCE and TCE groundwater plume. It is assumed the thallium and manganese concentrations, which are limited to an area to the west of Ashumet Pond, will decrease to concentrations below clean up goals without active treatment (AFCEE 2007c).

A.2. Initial Responses.

CERCLA Actions. Remedial actions performed at the FTA-1 source area consisted of soils excavation and on-site thermal treatment. The treatment of contaminated soils at FTA-1 began in June 1995 and was completed in September 1997. A total of 42,531 tons of soil were excavated, thermally treated, and backfilled. The Final Closure Report, FTA-1 Site outlines the soil excavation, thermal treatment, and backfilling activities. Refer to Section 3.2.29 regarding current status of FTA-1.

Remedial actions at the CS-16/CS-17 source area consisted of excavation and off-site disposal of soils. The Final Remedial Action Report Area of Contamination CS-16/ CS-17 details the selected remedy for the CS-16/CS-17 source areas. Approximately 6,000 tons of soil were excavated for the CS-16/CS-17 source removal and disposed of off-site in fall 2001. Refer to Section 3.2.13 regarding the current status of CS-16/CS-17.

Non CERCLA Actions.

MMR STP Upgrade Program: The ANG has upgraded the STP to discharge effluent to new sand filter beds near the Cape Cod Canal. Demolition of the former STP concrete structures was completed in 1997 (Burt 1998). Remaining sludge in the Imhoff tanks was removed and treated in 1996 before demolition.

1998: The AV interim remedy decision included an extraction fence for the purposes of protecting Ashumet Pond from phosphorus related to discharge from the former STP infiltration beds. Since the decision was made in September 1997, additional data and analysis suggested that an extraction fence to protect Ashumet Pond from phosphorus may not be the most effective or beneficial approach and could result in detrimental effects on pond health.

AFCEE, in conjunction with the Technical Review and Evaluation Team (TRET), convened several forums in which local and state experts in phosphorus transport and phosphorus remediation evaluated uncertainties concerning phosphorus mobility, its effect on pond ecology, and potential implications for the current remedial strategy for the AV plume. The following general conclusions were drawn from these meetings:

- An extraction, treatment, and reinjection (ETR) approach is very inefficient given that phosphorus is largely bound (or *adsorbed*, approximately 99%) to aquifer media;
- USGS bench-scale and field scale tests (e.g., clean water injections) indicate that an operating ETR system may result in overall increases in phosphorus loading to the pond rather than reductions;

- No imminent threat or emergency exists since aquifer/pond data collected over the past six years indicate that a steady state exists in which concentrations in wells near the pond have not changed.

Based on these conclusions, AFCEE recommended a revised approach for phosphorus that did not include an extraction fence.

2001-2004: AFCEE implemented a three-prong approach to address phosphorus. The first element was an in-pond alum treatment to bind phosphorus that had built up in the deep, anoxic portion of Ashumet Pond. This alum treatment was conducted in September 2001 and has shown significant reductions of phosphorus available for spring and fall algae blooms. The second element involves continued monitoring of surface water quality parameters to assess the health of the pond. The third element was the installation of a geochemical barrier at the plume-pond interface on the northwest shore of Ashumet Pond in 2004. Data indicate the barrier has significantly reduced the phosphate load to the pond.

A.3. Basis for Taking Action. A detailed assessment of the migration of the plume and the potential risks to downgradient receptors was performed in the late 1980's and 1990. Additional RIs were conducted to address soil and groundwater contamination emanating from FTA-1 and CS-16/CS-17. The first RI report was completed in the late 1980's, with additional work completed in 1991 (ABB-ES 1991). This investigative work was updated in November 1994, with an additional RI report completed in 1995 (ABB-ES 1995).

The basis for taking action is the result of three risk evaluations conducted for the AV groundwater contamination (AFCEE 2007c, ABB-ES 1991 and 1995). Future residential exposure to contaminated groundwater present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of 1×10^{-5} and the acceptable EPA range of 1×10^{-4} to 1×10^{-6}. ERAs indicate that discharge of the plumes to surface waters do not pose a threat to ecological receptors.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and a summary of the remedy implementation at AV.

B.1. Regulatory Actions.

1994: A Plume Response Plan was developed to contain seven groundwater plumes simultaneously. The Plume Management Process Action Team helped coordinate development of this plan. The Plume Response Plan was used as a substitute for the Feasibility Study and as a basis to develop the Proposed Plan. The NGB, DoD, EPA, MassDEP, and local communities approved the plan, resulting in an accelerated effort toward "simultaneous containment" of the following seven groundwater plumes: AV, CS-10, Eastern Briarwood, FS-12, LF-1, SD-5, and Western Aquafarm.

1995: The NGB and EPA, with MassDEP concurrence, signed a ROD for Interim Action (known as the IROD) (ANG 1995). The *Record of Decision for Interim Action Containment of Seven Groundwater Plumes* presents the interim remedial action to address the seven contaminated groundwater plumes at MMR. It states that extraction and treatment will continue until the final remedy for the site is chosen. The interim and final remedies must be consistent with the clean-up goals for the entire MMR site. In summary, the interim remedy provides for:

- extracting contaminated groundwater at the leading edge of the contaminant plume and potentially extracting groundwater from hot spot areas identified during remedial design;
- pumping and conveying the extracted groundwater to a treatment system to remove contaminants;
- discharging the treated water back to the groundwater and/or other beneficial use;
- installing monitoring wells, measuring water levels, and sampling groundwater to monitor the performance of the extraction system;
- sampling the influent and effluent of the treatment system to monitor its performance;

- restricting groundwater use within the areas contained by the ETI through imposition of institutional controls; and conducting a review after five years of operation to ensure the remedy provides adequate protection of human health and environment.

1996: The NGB issued a 60% design report for plume containment. While the 60% design protected human health, it presented significant ecological impacts to the environment. AFCEE was brought in to manage the IRP. The TRET, consisting of various technical experts, were established as an independent review committee to provide advice and recommendations. After reviewing the 60% design document, the TRET developed recommendations for next steps for each plume.

1997: In response to the technical deficiencies of the 60% design for simultaneous containment of the IROD plumes, AFCEE, EPA and MassDEP introduced the Decision Criteria Matrix (DCM) process, an accelerated decision-making tool to refine cleanup decisions. The DCM process was applied to the AV groundwater plume. The DCM gave the public an opportunity to review alternatives and make suggestions for final cleanup measures prior to the interim remedy selection. In September 1997, the *Ashumet Valley Plume Response Decision Fact Sheet* (AFCEE 1997) was issued to document the decision to implement the interim remedy. The selected interim remedy involved: (1) an axial extraction fence to provide restoration of the Falmouth municipal well field impacted by the VOC plume; (2) an extraction fence to protect Ashumet Pond from phosphorus in the northern portion of the plume, and (3) a “nitrates offset” program that “provides a replacement for, and a more effective means of, addressing current and future loadings to surface water than in-plume nitrate treatment.” Items 2 and 3 were non-CERCLA remedies. The axial extraction fence described in Item 1 would not be installed south of Carriage Shop Road and the Air Force would monitor the natural attenuation of the uncaptured portion of the plume. Additional investigation, fate and transport modeling, and monitoring would be conducted in order to protect human and ecological health.

2007: The AV plume is currently undergoing the process to reach a final ROD which will include a decision for the leading edge of the plume.

2008: An assessment of the uncaptured portion of the Ashumet Valley plume (south of Hayway Road) was completed. The Air Force and the regulatory agencies have agreed to install an additional extraction well at the leading edge of the Ashumet Valley plume with construction planned for late 2008/early 2009.

B.2. Remedial Action Objectives. As a result of the risk assessments for AV, PCE, TCE, manganese, and thallium were identified as COCs for groundwater. It should be noted that the VOC cis-1,2-dichloroethene (cis-1,2-DCE), that had originally been considered an interim COC at AV, was not identified as a COC as a result of the risk assessment presented in the feasibility study (AFCEE 2007c). Because much of the groundwater within the western Cape Cod aquifer has been designated by the MassDEP as a potentially productive aquifer for drinking water, the state and federal drinking water standards (MCLs) are applicable cleanup levels for the COCs in the AV plume. Accordingly, following RAOs have been established for the AV plume (AFCEE 2007c):

- Prevent residential exposure to AV groundwater with TCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to AV groundwater with PCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to groundwater located between Kittridge Road and the western shore of Ashumet Pond that has been impacted by the AV plume and that contains manganese concentrations greater than the HA of 300 µg/L.
- Prevent residential exposure to groundwater located between Kittridge Road and the western shore of Ashumet Pond that has been impacted by the AV plume and that contains thallium concentrations greater than the MCL of 2 µg/L.
- Restore usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.

B.3. Remedy Description. The interim AV ETI system was installed and became operational in 1999 under the IROD. The final wellfield design for the interim system consisted of three extraction wells within the Crane Wildlife Management Area (CWMA) with the northernmost well located immediately south of Route 151, the second well located in the east-central portion of the CWMA (along a power line easement), and the third well located immediately north of Hayway Road (AFCEE 1999). The extracted water is transported through underground piping to a treatment facility within the CWMA along Sandwich Road. The extracted groundwater is treated using GAC filters through two modular treatment buildings. At startup in 1999, the system operated at 1,200 gallons per minute (gpm) with approximately 600 gpm treated in each of the two buildings. Discharge of the treated water back to the aquifer is accomplished through two infiltration trenches located along Sandwich Road and Currier Road. On 18 May 2007, an optimization of the AV ETI system was implemented as detailed in the *Final Ashumet Valley 2006 Optimization Technical Memorandum* (AFCEE 2007b). The evaluation presented in this technical memorandum concluded that improvements in the efficiency of the ETI system could be achieved by operating the system in a one well/one plant configuration. This optimized condition involves the operation of 95EW0703 alone at 350 gpm with the extracted water treated through Plant A only with extraction wells 95EW0701 and 95EW0702 turned off. Groundwater modeling simulations indicate that the established remedial action objectives are predicted to be met under this optimized condition in the vicinity of the ETI system with little impact on the predicted restoration timeframe. Benefits of operating under a one well/one plant configuration include reduced operation and maintenance costs through reduced carbon usage, power consumption, and plant/well maintenance.

B.4 Remedy Implementation. Described below is a summary of the implementation of the interim remedy to address the AV chlorinated VOC plume. Please note that only major modifications are presented below. Modifying extraction and reinjection flow rates is an ongoing optimization process based on results of remedial system performance monitoring.

- System Operation: Between system startup in November 1999 and May 2007, the AV ETI system pumped 1,200 gpm from the aquifer using three extraction wells and returned the treated water through two subsurface infiltration trenches. As noted above, in May 2007 two of the three extraction wells were shut down and the ETI system was modified to operate at a total flow rate of 350 gpm. Through December 2007, over 4.4 billion gallons of groundwater have been treated by the ETI system, removing over 280 lbs of PCE and TCE.
- Groundwater Monitoring: The AV SPEIM program evaluates hydraulic, chemical, and plant operational data collected during pre-operation, start-up and continued operation of the AV ETI system. Groundwater modeling is used to assess capture zones, aquifer stresses under operational conditions, and optimization opportunities.
- Surface Water Monitoring: Surface water is monitored at Ashumet Pond and the Backus River.

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review for the AV plume.

- System Operation and Optimization: Based on a review of performance monitoring data collected under the SPEIM program, the AV ETI system was optimized in May 2007 (AFCEE 2007b).
- A Final AV Groundwater Feasibility Study was completed in 2007 (AFCEE 2007c).
- A Proposed Plan was completed in 2007 (AFCEE 2007a).
- A data gap investigation was completed in the southern portion of the plume to provide additional data to support final remedy decisions associated with the portion of the plume located downgradient of the interim ETI system (AFCEE 2008a).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3. The interim remedial system is functioning as intended and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been no changes in standards or To Be Considered (TBC) guidance.

Changes in Exposure Pathways: There have been no changes to exposure pathways or land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics. There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods: There were no changes in risk assessment methodology.

Review of RAOs: The RAOs developed for the final ROD (to be released in 2009) are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations.

F. Protectiveness Statement

The interim remedy is protective in the short-term; however, in order for the final remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

ABB-ES. 1995. *Draft Ashumet Valley Groundwater Operable Unit Remedial Investigation Report*. Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP, Oak Ridge, TN.

_____. 1991. *Phase I Study*. Installation Restoration Program, Massachusetts Military Reservation. Prepared for HAZWRAP, Oak Ridge, TN.

AFCEE. 2008a (June). *Ashumet Valley 2008 Data Gap Investigation and Plume Shell Update Project Note.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2008b (March). *Ashumet Valley 2007 Summary Letter Report.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2007a (June). *Proposed Plan for Ashumet Valley Groundwater:* Fact Sheet 2007-01. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2007b (May). *Final Ashumet Valley 2006 Optimization Technical Memorandum.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

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_____. 1999 (October). *Final Ashumet Valley Axial Wellfield Design Report*. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA.

_____. 1997 (September). *Ashumet Valley Plume Response Decision Fact Sheet*. Prepared by AFCEE, Installation Restoration Program, Otis ANG Base, MA.

ANG. 1995 (September). *Final Record of Decision for Interim Action Containment of Seven Groundwater Plumes at MMR, Cape Cod, MA.* Prepared by Stone & Webster Environmental Technology & Services for ANG Readiness Center, Installation Restoration Program, Otis ANG Base, MA.

Burt, B. 1998 (May). Personal communication between Bob Burt of the MMR Civil Engineering Office and Mike Gunderson, HAZWRAP.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.2 Chemical Spill No. 4 (CS-4) Groundwater

A. Background

A.1. Site Description. The CS-4 plume (Figure 4-2) is a component of the SWOU. The CS-4 plume is detached from its source area. The COCs for the CS-4 plume are PCE, TCE, EDB, and 1,1,2,2-tetrachloroethane (1,1,2,2-TeCA) (AFCEE 2000).

The source area for the CS-4 plume is a former motor pool used from 1941 to 1973 and a Defense Reutilization and Marketing Office that operated from 1956 to 1983. Spills, leaks, and disposal at the area have resulted in a groundwater plume.

A.2. Initial Responses. An interim ROD entitled "*Interim Remedial Action for the West Truck Road Motor Pool AOC (CS-4) Groundwater Operable Unit*" was developed to implement a remedy to address groundwater contamination at CS-4. In 1993, an ETI system was installed and became operational. Arranged in a fence configuration perpendicular to the direction of groundwater flow, thirteen extraction wells were used to capture the CS-4 plume. The influent was treated using GAC and then discharged via two infiltration trenches. However results of the SWOU RI indicated that the interim extraction system was not capturing the entire CS-4 plume (AFCEE 1999c). In May 2003, AFCEE, with concurrence from EPA and MassDEP, turned off the original CS-4 treatment system because of its ineffectiveness.

AFCEE has conducted several source removals at CS-4 West Truck Road Motor Pool. In 1994, more than 13,000 tons of contaminated soils at the CS-4 site were treated using an on-site thermal treatment unit. AFCEE removed 24 drainage structures and 3,000 tons of contaminated soil from the CS-4 source area in 1996. In 2001, an additional 5,200 tons of contaminated soils, along with an old UST, were removed from the site. Refer to Section 3.2.3 for the current status for CS-4 West Truck Road Motor Pool Source Area.

A.3. Basis for Taking Action. The basis for taking action is the presence of chlorinated VOCs and the results of the risk assessment presented in the SWOU RI (AFCEE 1999c). The baseline cancer risk calculations in the SWOU RI indicated that unless remedial action is undertaken, future residential exposure to contaminated groundwater may present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of $1x10^{-5}$ and the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$.

B. Remedial Actions

This section presents the regulatory actions, RAOs, and remedy description for the CS-4 plume.

B.1. Regulatory Actions. A feasibility study was completed in 1999 (AFCEE 1999b). Three of six alternatives were retained for alternatives analysis [i.e., (1) No remedial action with long term monitoring; (5) Continue operation of the existing CS-4 treatment system operation with the addition of new extraction wells. If additional capacity is required, add a mobile carbon treatment system. The existing extraction well fence would not be used. (6) Continue operation of the existing CS-4 treatment system operation with the addition of new extraction wells. If additional capacity is required, water would be piped to the proposed treatment plant for the CS-20 plume. The existing extraction well fence would not be used].

A Proposed Plan was released to the public in June 1999 (AFCEE 1999a) to solicit comments on the preferred alternative (Alternative 6). The selected remedy is documented in a ROD (AFCEE 2000).

B.2. Remedial Action Objectives. The RAOs presented in the ROD (AFCEE 2000) are as follows:

- Prevent or reduce residential exposure to EDB, PCE, TCE, 1,1,2,2-TCA in excess of cleanup standards in groundwater.

Contaminant	Concentration (µg/L)	Standard
EDB	0.02	MMCL
PCE	5	MCL
TCE	5	MCL
1,1,2,2-TCA	2	MassDEP MCP GW-1

- Restore the aquifer to its beneficial uses within a reasonable timeframe.

B.3. Remedy Description. The selected remedy in the ROD (AFCEE 2000) included the following:

- The CS-4 system will be developed in conjunction with the CS-20 system. Three extraction wells will be installed along the southwestern edge of the plume.
- Institutional controls are currently in place to mitigate exposure to humans from EDB-contaminated groundwater. In 1999, the Falmouth BOH adopted water well regulations to minimize the risk of exposure to groundwater contamination. Furthermore, residents potentially impacted by the plume are connected to a public water supply. The Commonwealth of Massachusetts will enforce restrictions on public water supplies within the CWMA. On-post residents and worker obtain water from a public water supply.
- This alternative includes monitoring of the plume and performance monitoring of the treatment systems. Ecological sampling would also be conducted as part of this alternative. The focus of ecological sampling is to measure the impact that treatment systems (not the plume) have on the environment.

The new CS-4 remedial system was installed and started operation in 2005. This new CS-4 system was installed as part of the Southwest plumes remedial system as described in the *Final CS-4, CS-20, CS-21, and FS-29 Wellfield Design Report* (AFCEE 2004). Further details of the new CS-4 system are as follows:

- The Southwest plumes remedial system was designed and installed to collectively remediate the CS-4, CS-20, CS-21, and FS-29 groundwater plumes (AFCEE 2004). The contaminated groundwater is captured by extraction wells in each plume, treated in a centrally located treatment plant, the Hunter Avenue Treatment Facility (HATF), and the treated water is returned to the aquifer through reinjection wells, an infiltration trench, and an infiltration gallery.
- The three CS-4 extraction wells were installed as described in the *Final CS-4, CS-20, CS-21, and FS-29 Wellfield Design Report* (AFCEE 2004). However, a Draft ESD was submitted in March 2007 to document changes to the selected remedies for CS-4, CS-20, and FS-29 (AFCEE 2007). The primary difference between the cleanup strategy identified in the ROD and the current design is that the selected alternative presented in the ROD anticipated that all of the groundwater within the CS-4 plume would be captured by the remedial system; however, the final design will allow the groundwater contamination in the downgradient leading edge of CS-4 to reach cleanup levels through natural attenuation instead of through active remediation. While analyzing various designs for system performance, effectiveness, property access issues, and other constraints, the final design for CS-4 was developed to meet the RAOs while allowing for a relatively small portion of the plume to attenuate naturally. The ESD language has been finalized and distribution of the final, signed ESD is scheduled for the summer of 2008.

B.4. Remedy Implementation. The institutional controls component of the selected remedy has been implemented. The original CS-4 ETI system operated between September 1993 and May 2003. During that timeframe, the original system treated approximately 663 million gallons of groundwater and removed approximately 10 lbs of COCs. The new CS-4 remedial system began operation on 28 November 2005 with a design flow rate of 620 gpm. The new CS-4 remedial system has treated approximately 622 million gallons of groundwater and has removed approximately 13 lbs of COCs through December 2007 (AFCEE 2008).

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review.

- Southwest Plumes Wellfield Design completed in August 2004 (AFCEE 2004).
- As part of Phase I of the Southwest Plumes system startup, the CS-4 remedial system began operation on 28 November 2005 with a design flow rate of 620 gpm.

- The CS-4 remedial system was optimized in March 2008, reducing the flow rate from its three extractions wells to a total of 398 gpm.
- The Draft Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, and Fuel Spill-29 Groundwater Plumes was submitted in March 2007 and comment resolution was reached in July 2008.

D. Technical Assessment. The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3

The remedial system is functioning as intended by the ROD and ESD and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: There have been no changes in standards or TBC guidance.

<u>Changes in Exposure Pathways</u>: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods: There were no changes in risk assessment methodology.

Review of RAOs: The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long term protectiveness.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations. RAOs should be modified as described in Question B.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008 (March). *Southwest Plumes 2007 Summary Letter Report.* Prepared by CH2M HILL for AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2007 (March). *Draft Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, and Fuel Spill-29 Groundwater Plumes.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2004 (August). *Final Chemical Spill-4, Chemical Spill-20, Chemical Spill-21, and Fuel Spill-29 Wellfield Design Report.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2000 (February). *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 1999a (June). *Final Proposed Plan for the Southwest Operable Unit.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 1999b (June). *Final Southwest Operable Unit Feasibility Study.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 1999c (May). *Final Southwest Operable Unit Remedial Investigation.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.3 Chemical Spill No. 10 (CS-10) Groundwater

A. Background

A.1. Site Description. The CS-10 groundwater plume (Figure 4-3) is located at the southeast corner of the MMR. The COCs for the CS-10 plume are TCE and PCE (AFCEE 2003), but other contaminants (i.e., EDB) are present at lower concentrations. The CS-10 groundwater contamination is a result of a number of potential sources; however, the main contributor is the BOMARC/UTES.

Currently, the CS-10 plume is divided into four areas based on the interim remedial systems that have been installed, and the plume cleanup decision to be made. There are four components of the CS-10 groundwater contamination: (1) the Sandwich Road lobe (2) the in-plume area (3) southern trench area (4) and the leading edge which is composed of three lobes: the northern lobe (formerly known as the TCE plume); north-central lobe; and southern lobe. The CS-10 plume is one of the seven groundwater plumes included in the IROD (ANG 1995), and is currently undergoing the IROD to Final ROD process.

A.2. Initial Responses.

<u>CERCLA Actions:</u>

CS-10 Source Area Remedial Action: Refer to Section 3.2.9 for the status of the CS-10 Source Area. Over 1,500 tons of contaminated soil were excavated from the CS-10 source area and transported off site. An SVE system was in operation in the CS-10 source area from 2002 to 2005 and during this time the system removed approximately 5 lbs of VOCs from the soil.

Mashpee Private Well Moratorium: The Mashpee BOH adopted a moratorium on groundwater wells which states that existing and future residential wells located in

documented or anticipated areas of groundwater contamination as defined by the BOH are restricted from use for any purpose (AFCEE 2002).

Residential Well Sampling Program: Workers and residents at MMR are connected to a public water supply. Most residents of Mashpee in the plume areas have been connected to public water supply. AFCEE conducts an annual residential sampling program in which AFCEE tests residential wells and irrigation wells potentially impacted by plumes for VOCs and/or EDB. In some cases, residential wells are tested more frequently.

Time-Critical Removal Action (for Northern Lobe): One extraction well was installed in January 2000 to prevent discharge of TCE into Johns Pond by containing the plume at Hoophole Road. Extracted water is piped to the Sandwich Road Treatment Facility (SRTF).

Non-CERCLA Actions: Several non-CERCLA source removal activities occurred at the CS-10 source area in 1996. At the CS-10 source area, 15 drainage structures were removed as part of the DSRP. For more information regarding the CS-10 source area, refer to Section 3.2.9.

A.3. Basis for Taking Action. The basis for taking action is the result of two risk assessments conducted for the CS-10 groundwater contamination (CDM 1996 and AFCEE 2001). Future residential exposure to contaminated groundwater present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of 1×10^{-5} and the acceptable EPA range of 1×10^{-4} to 1×10^{-6}. ERAs indicate that discharge of the CS-10 plume to surface waters do not pose a threat to ecological receptors.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and implemented remedy for the CS-10 plume.

B.1. Regulatory Actions.

1994: A Plume Response Plan was developed to contain seven groundwater plumes simultaneously. The Plume Management Process Action Team helped coordinate development of this plan. The Plume Response Plan was used as a substitute for the Feasibility Study and as a basis to develop the Proposed Plan. The NGB, DoD, EPA, MassDEP, and local communities approved the plan, resulting in an accelerated effort toward "simultaneous containment" of the following seven groundwater plumes: AV, CS-10, Eastern Briarwood, FS-12, LF-1, SD-5, and Western Aquafarm.

1995: The NGB and EPA, with MassDEP concurrence, signed a ROD for Interim Action (known as the IROD) (ANG 1995) for seven groundwater plumes identified at the MMR. The IROD enabled the NGB to take immediate action to protect human health and the environment, while collecting additional information to evaluate and select final cleanup alternatives.

1996: The NGB issued a 60% design report for plume containment. While the 60% design protected human health, it presented significant ecological impacts to the environment. AFCEE was brought in to manage the IRP. The TRET, consisting of various technical experts, was established as an independent review committee to provide advice and recommendations. After reviewing the 60% design document, the TRET developed recommendations for next steps for each plume.

1997: In response to the technical deficiencies of the 60% design for simultaneous containment of the IROD plumes, AFCEE, EPA and MassDEP introduced the DCM process, an accelerated decision-making tool to refine cleanup decisions. The DCM process was applied to the CS-10 groundwater plume. The DCM gave the public an opportunity to review alternatives and make suggestions for final cleanup measures prior to the remedy selection. In December 1997, the *CS-10 Plume Response Decision Fact Sheet* (AFCEE 1997) was issued to document the decision to implement the remedy.

2007: The CS-10 plume is currently undergoing the process to reach a final ROD which will include a decision for the entire CS-10 plume.

B.2. Remedial Action Objectives. As a result of the risk assessments for CS-10, PCE and TCE were identified as COCs for groundwater (AFCEE 2007a). Because much of the groundwater within the western Cape Cod aquifer has been designated by the MassDEP as a potentially productive aquifer for drinking water, the state and federal drinking water standards (MCLs) are applicable cleanup levels for the COCs in the CS-10 plume; the federal MCL for TCE and PCE is 5 µg/L. Accordingly, the following RAOs were established for the CS-10 plume during the feasibility study process:

- Prevent residential exposure to CS-10 groundwater containing concentrations of TCE or PCE greater than 5 µg/L.
- Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.

B.3. Remedy Description. As a result of the DCM process, multiple systems were selected for cleanup of the CS-10 plume. The CS-10 groundwater plume is being remediated by the CS-10 In-Plume ETI treatment system, CS-10 Sandwich Road ETR system, and the Northern lobe extraction well. Descriptions for these interim systems as originally configured are provided below. Please note that modifications to the interim systems are discussed in Section B.4.

CS-10 Sandwich Road ETR System: The CS-10 Sandwich Road ETR system initial design consisted of eight extraction wells, GAC, and six reinjection wells. The extracted groundwater is processed through the SRTF. At the SRTF, the extracted groundwater is treated using GAC to remove contaminants. After treatment, the water is returned to the aquifer through a combination of six CS-10 Sandwich Road reinjection wells and eight SD-5 North reinjection wells.

CS-10 In-Plume ETI System: The CS-10 In-Plume ETI system initial design consisted of five extraction wells, two modular treatment buildings (each with one GAC train) and two infiltration trenches. The infiltration trenches were designed to place water back into the aquifer near ground surface. Three additional extraction wells which were initially referred to as the Southwest/Southern system were added to the CS-10 In-Plume system in 2000 and a ninth extraction well was installed in 2004.

CS-10 Northern Lobe Extraction Well: Extracted groundwater from the Northern lobe extraction well is pumped to the SRTF and is returned to the aquifer through a combination of the six CS-10 Sandwich Road reinjection wells and the eight SD-5 North reinjection wells.

B.4. Remedy Implementation. Described below are interim remedies that address the CS-10 groundwater contamination as documented in the *CS-10 Plume Response Decision Fact Sheet* (AFCEE 1997). AFCEE is in the process of completing a final ROD. Three groundwater remediation systems were constructed to address CS-10 groundwater contamination as follows:

Groundwater Treatment Systems:

- CS-10 Sandwich Road ETR System: The CS-10 Sandwich Road ETR system startup date was May 18, 1999 with eight extraction wells operating at a total flow rate of 820 gpm. The objective of this system is to contain the CS-10 plume at Sandwich Road. The system, having gone through numerous optimizations, currently extracts groundwater from six extraction wells operating at a total flow rate of 770 gpm, which is then treated using GAC filters to remove contaminants, including chlorinated VOCs. After treatment, the water is returned to the aquifer through a combination of six CS-10 Sandwich Road reinjection wells and eight SD-5 north reinjection wells. In May 2001, extraction well, 03EW2170 was taken out of operation (AFCEE 2002a) and in March 2005 extraction well 03EW2177 was taken out of operation. The ETR system has removed approximately 974 lbs of COCs from startup through December 2007 (AFCEE 2008a). During this period, the SRTF ETR system has processed approximately 3.6 billion gallons of groundwater. TCE concentrations in the Sandwich Road lobe have decreased significantly from baseline concentrations since startup of the Sandwich Road ETR system. The highest TCE concentration was 5,110 µg/L in

the baseline plume delineation. The current maximum concentration in the CS-10 Sandwich Road lobe is 195 µg/L (AFCEE 2007b).

- CS-10 In-Plume ETI System: The main body of the plume is addressed by the CS-10 In-Plume ETI treatment system. The placement of a treatment system within the plume reduces higher concentrations of contaminants for aquifer restoration. Extracted and treated groundwater is discharged into two infiltration trenches. The CS-10 In-Plume ETI System began operation on 24 June 1999 with a design flow rate of 1,200 gpm. Three additional CS-10 S/SW extraction wells and additional treatment capacity came on-line on 27 April 2000 adding an additional 780 gpm. A ninth extraction well began operation in 02 October 2004 at a flow rate of 500 gpm. Numerous optimizations have occurred resulting in a current total flow rate of 2,760 gpm. The treatment system has removed approximately 3,519 lbs of COCs from startup through December 2007 (AFCEE 2008a). During this period, the In-Plume ETI system has processed approximately 11 billion gallons of groundwater. Contaminant concentrations in the in-plume area have generally decreased as a result of the CS-10 In-Plume extraction system. However, increasing TCE concentrations in the southern trench area, outside of the remedial system capture zone, prompted the need for a data gap investigation in this area (AFCEE 2008b). AFCEE and the regulatory agencies are currently evaluating alternatives to address contamination in the southern trench area and a southern trench extraction well and a reinjection well are scheduled for installation in late 2008.
- CS-10 Northern Lobe Extraction Well: The Northern lobe extraction well started operation in January 2000 at a flow rate of 75 gpm to prevent discharge of TCE into Johns Pond by containing the plume at Hoophole Road. The Northern lobe extraction well has been optimized to a current flow rate of 175 gpm and has removed approximately 180 lbs of COCs from system startup through December 2007 (AFCEE 2008a). During this period, the Northern lobe system has processed approximately 0.5 billion gallons of groundwater.

Groundwater Monitoring: The CS-10 SPEIM program evaluates hydraulic, chemical and plant operational data collected during pre-operation, start-up and continued operation of the CS-10 remedial systems. Groundwater modeling is used to assess capture zones, aquifer stresses under operational conditions, and optimization opportunities.

Surface Water Monitoring: Surface water is monitored at Ashumet Pond and Johns Pond.

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review:

- Operation of the CS-10 Source Area SVE system (from 2002 through 2005).
- Submittal of Final Chemical Spill-10 Groundwater Feasibility Study (AFCEE 2003).
- Submittal of Chemical Spill-10 Southern Trench Area Remedial Technologies Identification and Screening Memorandum (AFCEE 2007a).
- Submittal of Final Chemical Spill-10 Groundwater Feasibility Study Addendum (AFCEE 2007b).
- CS-10 Source Area Investigation (AFCEE 2007c).
- Installation and startup of CS-10 In-Plume extraction well 03EW2111 in October 2004.
- Optimization of the CS-10 In-Plume, Sandwich Road, and Northern lobe remedial systems to Scenario 56 operating conditions (AFCEE 2005b).
- CS-10 Leading Edge Data Gap Investigation (AFCEE 2005a).
- CS-10 Southern Trench Data Gap Investigation (AFCEE 2008b).
- Initiation of a pilot test of in-situ chemical oxidation in an area located upgradient of CS-10 In-Plume extraction well 03EW2109.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3. The interim remedial system is not functioning as intended since a portion

of the CS-10 plume in the southern trench area has moved beyond the base boundary. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods: There were no changes in risk assessment methodology.

Review of RAOs: The RAOs developed for the final ROD (to be released in 2009) are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/ Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations. The Air Force has begun the process to construct an additional extraction well to address the CS-10 southern trench area. Completion of this project is anticipated in late 2008.

F. Protectiveness Statement

The interim remedy is protective in the short-term; however, in order for the final remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008a (March). *CS-10 2007 Summary Letter Report.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2008b (January). *Final Chemical Spill-10 2007 Southern Trench Technical Memorandum.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2007a (October). *Chemical Spill-10 Southern Trench Area Remedial Technologies Identification and Screening Memorandum*. Prepared by Jacobs Engineering Group for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2007b (May). *Final Chemical Spill-10 Groundwater Feasibility Study Addendum*. Prepared by Jacobs Engineering Group for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2007c (February). *CS-10 2006 Summary Letter Report.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2005a (October). *Final Chemical Spill-10 Leading Edge Technical Memorandum.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2005b (April). *Final Chemical Spill-10 2004 System Performance and Ecological Impact Monitoring Report.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2003 (August). *Final Chemical Spill-10 Groundwater Feasibility Study*. Prepared by Jacobs Engineering Group for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2002 (July). *Final Combined Storm Drain-5 and Chemical Spill-10 2001 Annual System Performance and Ecological Impact Monitoring Report.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2001 (September). *Final Chemical Spill-10 Remedial Investigation Report.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 1997 (December). *CS-10 Plume Response Decision Fact Sheet*. Prepared by AFCEE, Installation Restoration Program, Otis ANG Base, MA.

ANG. 1995 (September). *Final Record of Decision Interim Remedial Action Containment of Seven Groundwater Plumes at MMR, Cape Cod MA.* Prepared by Stone & Webster Environmental & Technology Services for ANG Readiness Center, Installation Restoration Program, Otis ANG Base, MA.

CDM Federal Programs Corporation. 1996 (July). *Final Remedial Investigation, UTES/BOMARC and BOMARC Area Fuel Spill, AOC CS-10 Groundwater Operable Unit: CS-10D and Hydrogeologic Region II Study*. Volume I. Prepared for AFCEE/MMR Installation Restoration Program and ANG, Otis ANG Base, MA. Submitted by HAZWRAP, Oak Ridge, Tennessee.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.4 Chemical Spill No. 19 (CS-19) Groundwater

A. Background

A.1. Site Description. The CS-19 groundwater plume (Figure 4-4) is located in the west-central region of the MMR Impact Area. The CS-19 plume is located in, and commingled with, the CIA groundwater plume and study area. The COC for CS-19 is Royal Demolition Explosive (RDX). The source of the CS-19 groundwater plume is an inactive site historically used for ordnance disposal.

A.2. Initial Responses. None.

A.3. Basis for Taking Action. RDX was detected above the HA level of 2 µg/L in several monitoring wells.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and remedy implementation for the CS-19 plume.

B.1. Regulatory Actions. The CS-19 RI was completed in 2003 and concluded that the groundwater is of sufficiently low risk to humans that active cleanup of the plume is not necessary at this time and modeling indicates that the plume will dissipate naturally if the source is removed (AFCEE 2003). AFCEE is currently in the process of removing the source, and an interim monitoring program was established in September 2004 to monitor the anticipated natural attenuation of the plume (AFCEE 2004). This interim approach was documented in the *Final CS-19 Groundwater Plume Interim Record of Decision* (AFCEE 2006). A final groundwater remedy will be selected after the Impact Area Groundwater Study Program completes a Feasibility Study for the CIA.

B.2. Remedial Action Objectives. The RAOs presented in the IROD are as follows:

- Prevent or reduce residential exposure to water containing unacceptable concentrations of RDX.
- Return useable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.

B.3. Remedy Description. The selected interim remedy for CS-19 is long term monitoring (LTM) with LUCs (AFCEE 2006). A final remedy will be evaluated and selected in conjunction with the remedy selection for the CIA plume.

B.4. Remedy Implementation. LTM was initiated in 2004 (AFCEE 2004).

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review.

- Final RI completed in October 2003 (AFCEE 2003).
- The Final Chemical Spill-19 Groundwater Plume IROD was completed in April 2006 (AFCEE 2006).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

Yes, LTM data indicate that concentrations within the CS-19 plume are decreasing. On-base LUCs are protective.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: The MassDEP has added a new GW-1 standard to the MCP for RDX of 1 μg/L, effective February 2008.

Changes in Exposure Pathways: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: The MassDEP has added a new GW-1 standard to the MCP for RDX of 1 μg/L, effective February 2008.

Changes in Risk Assessment Methods: None

Review of RAOs: The Interim RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long term protectiveness when the final ROD for CS-19 is developed in 2009.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

Final RAOs should be developed as described in Question B.

F. Protectiveness Statement

The interim remedy is protective.

G. References

AFCEE. 2006 (April). *Final Chemical Spill-19 Groundwater Plume Interim Record of Decision.* Prepared by Jacobs Engineering Group Inc., for AFCEE/MMR, IRP, Otis ANG Base, MA.

_____. 2004 (September). Project Note: *Chemical Spill-19 (CS-19) Groundwater Monitoring Plan*. Prepared by Jacobs Engineering Group Inc., for AFCEE/MMR, IRP, Otis ANG Base, MA.

_____. 2003 (September). *Final Chemical Spill-19 Remedial Investigation Report.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, IRP, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.5 Chemical Spill No. 20 (CS-20)

A. Background

A.1. Site Description. The CS-20 plume (Figure 4-5) is a component of SWOU. The CS-20 plume is detached from its source area, the location of which is unknown. The COC for the CS-20 plume is PCE.

A.2. Initial Responses. AFCEE funded the Town of Falmouth to extend public water supply lines and hook-up homes in neighborhoods potentially impacted by CS-20.

A.3. Basis for Taking Action. PCE has been identified as the COC for CS-20 with historic concentrations as high as 71 µg/L. Calculated risk for the CS-20 plume based on reasonable maximum exposure to future residents exceeds the MassDEP allowable risk of 1×10^{-5}.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and remedy implementation for the CS-20 plume.

B.1. Regulatory Actions. The *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes* (AFCEE 2000) is the controlling document for the CS-20 plume. The selected remedy for the CS-20 plume includes design, construction, and operation of an ETR system to hydraulically capture and treat contaminants; LTM of the plume; performance monitoring and evaluation of the treatment system; ecological sampling to monitor the impacts of the system to the environment; and institutional controls to protect residents from exposure to SWOU groundwater contaminants. The remedy (Alternative 5) was selected from the analysis of eight alternatives presented in the SWOU Feasibility Study (AFCEE 1999a). The Proposed Plan presenting the preferred alternative was released to the public for comment in June 1999 (1999b).

B.2. Remedial Action Objectives. The RAOs presented in the ROD (AFCEE 2000) are as follows:

- Prevent or reduce residential exposure to PCE exceeding 5 μg/L in groundwater.
- Restore the aquifer to its beneficial uses within a reasonable time.

B.3. Remedy Description. For all of the SWOU plumes, institutional and engineering controls have been implemented to protect off-post and on-post residents. For Falmouth residents, a permit is required from the Falmouth BOH prior to installation of a well for drinking water; if the permit is granted, water must be tested for VOCs and EDB prior to use. If the Falmouth BOH grants a permit for installation of a well that is located above a plume, AFCEE will regularly sample the well. Furthermore, AFCEE will sample drinking wells installed prior to the promulgation of the Falmouth BOH regulations that are located above the plume, within 500 feet crossgradient of the plume, or 1,500 feet downgradient of a plume for which public water connections are not provided. On-post residents and workers receive their water from the base water supply system.

The ETR system was modeled using a flow rate of 500 gpm. In the modeled scenario, groundwater from three extraction wells each pumping 166 gpm would be processed through a pair of GAC units aligned in series. The SWOU remedial system was designed and installed to collectively remediate the CS-4, CS-20, CS-21, and FS-29 groundwater plumes (AFCEE 2004). The contaminated groundwater is captured by extraction wells in each plume, treated in a centrally located treatment plant, the HATF, and the treated water is returned to the aquifer through reinjection wells, an infiltration trench, and an infiltration gallery.

Three extraction wells were originally intended to remediate the CS-20 plume (AFCEE 2004); however, the southernmost extraction well was not installed due to access issues. A Draft ESD was submitted in March 2007 to document changes to the selected remedies for CS-4, CS-20, and FS-29 (AFCEE 2007). The primary difference between the cleanup

strategy identified in the ROD and the current design is that the selected alternative presented in the ROD anticipated that all of the groundwater within the CS-20 plume would be captured by the remedial system; however, the final design will allow the groundwater contamination in the downgradient leading edge of CS-20 to reach cleanup levels through natural attenuation instead of through active remediation. While analyzing various designs for system performance, effectiveness, property access issues, and other constraints, the final design for CS-20 was developed to meet the RAOs while allowing for a relatively small portion of the plume to attenuate naturally. The ESD language has been finalized and distribution of the final, signed ESD is scheduled for the summer of 2008.

B.4. Remedy Implementation. The institutional controls component of the selected remedy has been implemented. The CS-20 remedial system began operation on 11 January 2006 at a flow rate of 775 gpm. The CS-20 remedial system has treated approximately 724 million gallons of groundwater and has removed approximately 44 lbs of PCE through December 2007 (AFCEE 2008).

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review.

- Southwest Plumes Wellfield Design completed in August 2004 (AFCEE 2004).
- As part of Phase I of the Southwest Plumes system startup, the CS-20 remedial system began operation on 11 January 2006 at a flow rate of 775 gpm.
- The Draft Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, and Fuel Spill-29 Groundwater Plumes was submitted in March 2007 and comment resolution was reached in July 2008.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3. The remedial system is functioning as intended by the ROD and ESD and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: There have been no changes in standards or TBC guidance.

<u>Changes in Exposure Pathways</u>: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: There have been no changes in the toxicity factors for COCs.

<u>Changes in Risk Assessment Methods</u>: There were no changes in risk assessment methodology.

<u>Review of RAOs</u>: The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long term protectiveness.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations. RAOs should be modified as described in Question B.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008 (March). *Southwest Plumes 2007 Summary Letter Report.* Prepared by CH2M HILL for AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2007 (March). *Draft Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, and Fuel Spill-29 Groundwater Plumes.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2004 (August). *Final Chemical Spill-4, Chemical Spill-20, Chemical Spill-21, and Fuel Spill-29 Wellfield Design Report.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2000 (February). *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 1999a (June). *Final Southwest Operable Unit Feasibility Study for the Southwest Operable Unit.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 1999b (June). *Final Southwest Operable Unit Proposed Plan for the Southwest Operable Unit.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.6 Chemical Spill No. 21 (CS-21) Groundwater

A. Background

A.1. Site Description. The CS-21 plume (Figure 4-6) is a component of the SWOU. The CS-21 plume is detached from its source area, the location of which is unknown. The COC for the CS-21 plume is TCE.

A.2. Initial Responses. AFCEE funded the Town of Falmouth to extend public water supply lines and hook-up homes in neighborhoods potentially impacted by CS-21.

A.3. Basis For Taking Action. TCE was identified as the COC at CS-21 with historic concentrations as high as 73.5 µg/L. Calculated risk for the CS-21 plume based on reasonable maximum exposure to future residents exceeds the MassDEP allowable risk of 1×10^{-5}.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and remedy implementation for the CS-21 plume.

B.1. Regulatory Actions. The *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes* (AFCEE 2000) is the controlling document for the CS-21 plume. The selected remedy for the CS-21 plume includes design, construction, and operation of an ETR system to hydraulically capture and treat contaminants; LTM of the plume; performance monitoring and evaluation of the treatment system; ecological sampling to monitor the impacts of the system to the environment; and institutional controls to protect residents from exposure to SWOU groundwater contaminants. The remedy (Alternative 11) was selected from the analysis of 11 alternatives presented in the SWOU Feasibility Study (AFCEE 1999a). The Proposed Plan presenting the preferred alternative was released to the public for comment in June 1999 (AFCEE 1999b).

B.2. Remedial Action Objectives. The RAOs presented in the ROD (AFCEE 2000) are as follows:

- Prevent or reduce residential exposure to TCE exceeding 5 µg/L in groundwater.
- Restore the aquifer to its beneficial uses within a reasonable time.

B.3. Remedy Description. For all of the SWOU plumes, institutional controls have been implemented to protect off-post and on-post residents. For Falmouth residents, a permit is required from the Falmouth BOH prior to installation of a well for drinking water; if the permit is granted, water must be tested for VOCs and EDB prior to use. If the Falmouth BOH grants a permit for installation of a well that is located above a plume, AFCEE will regularly sample the well. Furthermore, AFCEE will sample drinking wells installed prior to the promulgation of the Falmouth BOH regulations that are located above the plume, within 500 feet cross-gradient of the plume, or 1,500 feet downgradient of a plume for which public water connections are not provided. On-post residents and workers receive their water from the base water supply system.

The ETR system was modeled using five extraction wells for a combined flow rate of 1,200 gpm. In addition, a separate well processing 200 gpm would be constructed for specifically addressing the leading edge of the plume. However, the final design for CS-21 consisted of four extraction wells pumping at a combined rate of 1,400 gpm.

The SWOU remedial system was designed and installed to collectively remediate the CS-4, CS-20, CS-21, and FS-29 groundwater plumes (AFCEE 2004). The contaminated groundwater is captured by extraction wells in each plume, treated in a centrally located treatment plant (HATF) and the treated water is returned to the aquifer through reinjection wells, an infiltration trench, and an infiltration gallery. The four CS-21 extraction wells were installed as described in the *Final CS-4, CS-20, CS-21, and FS-29 Wellfield Design Report* (AFCEE 2004).

B.4. Remedy Implementation. The institutional controls component of the selected remedy has been implemented. The CS-21 remedial system began operation on 11 September 2006 at a flow rate of 1,400 gpm. The CS-21 remedial system has treated approximately 887 million gallons of groundwater and has removed approximately 49 lbs of TCE through December 2007 (AFCEE 2008).

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review.

- Southwest Plumes Wellfield Design completed in August 2004 (AFCEE 2004).
- As part of Phase II of the Southwest plume system startup, the CS-21 remedial system began operation on 11 September 2006 at a flow rate of 1,400 gpm.
- The Draft Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, and Fuel Spill-29 Groundwater Plumes was submitted in March 2007 (AFCEE 2007) and comment resolution was reached in July 2008.

D. Technical Assessment. The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3.

The remedial system is functioning as intended by the ROD and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods: There were no changes in risk assessment methodology.

Review of RAOs: The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long term protectiveness.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations. RAOs should be modified as described in Question B.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008 (March). *Southwest Plumes 2007 Summary Letter Report.* Prepared by CH2M HILL for AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2007 (March). *Draft Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, and Fuel Spill-29 Groundwater Plumes.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2004 (August). *Final Chemical Spill-4, Chemical Spill-20, Chemical Spill-21, and Fuel Spill-29 Wellfield Design Report.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2000 (February). *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 1999a (June). *Final Southwest Operable Unit Feasibility Study for the Southwest Operable Unit* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 1999b (June). *Final Southwest Operable Unit Proposed Plan for the Southwest Operable Unit.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.7 Chemical Spill No. 23 (CS-23) Groundwater

A. Background

A.1. Site Description. The CS-23 groundwater contamination was designated as a plume in 2002 during the CS-4, CS-20, CS-21, and FS-29 Pre-Design Investigation (AFCEE 2003). The CS-23 plume (Figure 4-7) consists of chlorinated VOC groundwater contamination between the LF-1, CS-10, and CS-21 plumes. The COCs for the CS-23 plume are TCE and carbon tetrachloride (CCl_4).

A.2. Initial Responses. None.

A.3. Basis for Taking Action. The basis for taking action is the result of a risk evaluation conducted for the CS-23 plume (AFCEE 2005). Future residential exposure to contaminated groundwater present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of $1x10^{-5}$ and the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. In addition, the non-cancer hazard calculations indicated that residential exposure to CS-23 groundwater inside the plume may present an unacceptable non-cancer hazard for a future residential exposure scenario.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and remedy implementation for the CS-23 plume.

B.1. Regulatory Actions.

Engineering Controls: Workers and residents at MMR are connected to a public water supply. Residents of Falmouth in the area of the CS-23 plume also have been connected to a public water supply.

2006: Feasibility Study. A streamlined feasibility study (AFCEE 2006a) was completed for the CS-23 Groundwater Operable Unit. Major components of the feasibility study included identification of RAOs and development of remedial alternatives. Five remedial alternatives were identified and received detailed and comparative analyses.

2006: CS-23 Wellfield Design Report. The CS-23 pre-design investigation for an on-base groundwater ETI system was conducted in 2004 and 2005. Groundwater screening and monitoring well installation were conducted at four locations. Lithologic characterization and grain-size analysis was conducted at two drilling locations. The results of the investigation, including a revised plume outline and plume shell were presented in the wellfield design report (AFCEE 2006c).

2007: Record of Decision. The selected remedy for the CS-23 Groundwater Operable Unit (i.e., Alternative Three: Remediation at the Base Boundary with LUCs and Long Term Monitoring) is documented in the Final Record of Decision for Chemical Spill-23 Groundwater (AFCEE 2007).

B.2. Remedial Action Objectives. The RAOs presented in the CS-23 ROD (AFCEE 2007) are as follows:

- Prevent residential exposure to CS-23 groundwater with TCE concentrations greater than the MCL of 5 µg/L.
- Prevent residential exposure to CS-23 groundwater with CCl_4 concentrations greater than the MCL of 5 µg/L
- Return useable groundwaters to their beneficial uses wherever practicable, with a time frame that is reasonable given the particular circumstances of the site.
- Prevent exposure to CS-23 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown, pursuant to Section 2.11.2 (of the CS-23 ROD), that such use does not present a carcinogenic risk in excess of the EPA target risk range of $1x10^{-4}$ to $1x10^{-6}$ or present a non-carcinogenic hazard index greater than 1.0.

B.3. Remedy Description. The CS-23 ETI system was installed and became operation in 2006 prior to the completion of the ROD. Contaminated groundwater is pumped via two extraction wells to the HATF where the COCs TCE and CCl_4 are removed by GAC. Treated water is returned to the aquifer via infiltration trenches. Process optimization will be performed based on chemical and hydraulic monitoring of the plume.

B.4. Remedy Implementation.

CS-23 ETI System: The two CS-23 extraction wells began pumping contaminated groundwater to the HATF on December 5, 2006 at a flow rate of 700 gpm. The COCs in groundwater are being removed by GAC. Treated water (i.e., effluent) is returned to the aquifer via two infiltration trenches. Chemical and hydraulic monitoring of the plume is being performed under the LF-1/CS-23 SPEIM program. Through December 2007, over 334 million gallons of groundwater have been treated by the CS-23 ETI system, removing approximately 17 lbs of COCs (AFCEE 2008a).

Groundwater Monitoring: The CS-23 SPEIM program evaluates hydraulic, chemical, and plant operational data collected during pre-operation, start-up and continued operation of the CS-23 ETI system. Groundwater modeling is used to assess capture zones, aquifer stresses under operational conditions, and optimization opportunities.

C. Progress Since the Last Five-Year Review

The following activities were conducted/ observed since the last review:

- A Final RI was completed in 2005 (AFCEE 2005).
- A Final Feasibility Study was completed in 2006 (AFCEE 2006a).
- A Proposed Plan was completed in 2006 (AFCEE 2006b)
- A Final Well Design Report was completed in 2006 (AFCEE 2006c).
- The two CS-23 extraction wells and two infiltration galleries became operational in December 2006 at a flow rate of 700 gpm. The extraction wells pump contaminated groundwater to the HATF for treatment. Treated water (effluent) is discharged to the infiltration galleries, which recharge the aquifer.
- A Final ROD was completed in September 2007 (AFCEE 2007).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater in the long term have not yet been fully implemented. See Section 4.3 for a further discussion.

The remedial system is functioning as intended by the ROD and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented and have indicated excessive drawdown of surface water at a nearby wetland and vernal pool (AFCEE 2008b).

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered, Toxicity, and Risk Assessment Methodology: Federal MCLs are the cleanup standards for TCE and CCl_4. The Federal MCL for either COC has not changed since the last five-year review.

Changes in Exposure Pathways: There have been no changes to exposure pathways that would affect the protectiveness of the remedy. Institutional/engineering controls that prohibit the use of contaminated groundwater are in place to mitigate exposure pathways to humans.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up

See Section 4.3 for a full discussion of the LUC issue and recommendations. The Air Force will continue to monitor the wetland and vernal pool near CS-23 for potential negative ecological impacts associated with the surface water drawdown.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008a (March). *LF-1/CS-23 2007 Summary Letter Report.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2008b (February). *Draft LF-1/CS-23 2007 Plume Update Technical Memorandum.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2007 (September). *Final Chemical Spill-23 Plume Record of Decision.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2006a (January). *Final Chemical Spill-23 Plume Feasibility Study.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

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EPA. 2001 (June). *Comprehensive Five Year Review Guidance*, EPA 540R-01-007.

4.4.8 Eastern Briarwood

A. Background

A.1. Site Description. The Eastern Briarwood groundwater contamination was a result of migration of contaminants (i.e., TCE and EDB) from industrial and military activities in the southeastern portion of the MMR. Potential sources of contamination in the Eastern Briarwood area may have included FS-25, CS-14, Central Heating Plant, Weapons Storage Area, and FS-1 (USCG).

A.2. Initial Responses. None.

A.3. Basis for Taking Action. The Eastern Briarwood site followed the CERCLA SI process. Described below is a summary of activities for the Eastern Briarwood site.

1994: SERGOU RI: The basis for taking action for groundwater were the site characterization and risk assessment results of the SERGOU RI completed in 1994 (ANG 1994). The Eastern Briarwood groundwater contamination was identified as a detached plume consisting of TCE that had migrated off-base and was located south of Moody Pond, north of Johns Pond, and upgradient of the Quashnet River.

1995 Interim Record of Decision: An IROD was completed in 1995 (ANG 1995) which presented a plume containment interim remedy for the Eastern Briarwood site. An interim response action to contain the Eastern Briarwood plume at the leading edge was developed that conceptually consisted of eight extraction wells, treatment of the contaminated water with GAC, and 16 reinjection wells on the MMR boundary. It was determined that implementation of this remedy could have an adverse impact on the surrounding ecosystem and also cause undesirable alterations to regional groundwater flow.

<u>1996 Data Gap Investigation</u>: In 1996, a data gap investigation was performed. Results of the data gap investigation indicated that contaminant concentrations were low. Based on the data gap investigation and potential negative effects of the conceptual remedial action, the approach for the Eastern Briarwood site was revised in the Strategic Plan (AFCEE 1997) from the active leading edge remedial system previously presented in the IROD to LTM.

<u>1996 – 2005 Long Term Monitoring Program</u>: In 1996, a LTM program was initiated for the Eastern Briarwood plume to assess contaminant trends and distributions. The primary contaminants detected in the Eastern Briarwood plume were TCE and PCE. In 1998, EDB was detected at concentrations above the Massachusetts Maximum Contaminant Level (MMCL). Between 1996 and 2005, monitoring wells were installed and over 750 groundwater samples were collected. Surface water samples and sediment samples were also collected from the Quashnet River. Contaminant concentrations decreased during this time period and in the fifth year of the monitoring program the Eastern Briarwood groundwater plume was eliminated.

<u>2005 Groundwater Risk Assessment</u>: In support of reaching a final ROD for the Eastern Briarwood site, a risk assessment was performed (AFCEE 2005) using data collected from the LTM program and supplemented by additional data specifically to support the risk assessment. The groundwater risk assessment used the following screening criteria: EPA Region IX preliminary remedial goals for residential tap water, EPA MCLs, and MassDEP MCP GW-1 groundwater standards.

Cancer risks and non-cancer hazards were evaluated for residential and recreational exposures to on-base groundwater, off-base solvent-impacted groundwater, off-base EDB-impacted groundwater, and Quashnet River surface water and sediment associated with the Eastern Briarwood site. Exposure to groundwater, surface water, and sediment were evaluated for both the adult and child receptor scenarios. No human-health contaminants of concern were selected based on the risk assessment results.

An ERA was performed for the Quashnet River. There is no ecological concern to aquatic and benthic populations in the Quashnet River associated with the Eastern Briarwood site.

B. Remedial Actions

This section presents the regulatory actions for the Eastern Briarwood site. Remedy description and RAOs are not applicable for the Eastern Briarwood site since it was determined during the risk assessment that a condition of no significant risk exists.

2006 Record of Decision: Based on the review of the risk assessment for the Eastern Briarwood site and the spatial and temporal distribution of TCE in Eastern Briarwood groundwater; the EPA, MassDEP, and AFCEE concluded that no further action was warranted to be protective of human health and the environment. The no further action decision is documented in the Final ROD for Groundwater at Eastern Briarwood, Western Aquafarm, and Storm-Drain 5 (AFCEE 2006).

C. Progress Since the Last Five-Year Review

The following activities were conducted/ observed since the last review.

- LTM of groundwater which began in 1996 was completed in 2005.
- Human health and ERAs were completed for the Eastern Briarwood site in 2005 (AFCEE 2005).
- A Final ROD was completed in September 2006 (AFCEE 2006) to document no further action for the Eastern Briarwood site.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the no further action decision is still applicable for the Eastern Briarwood site.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered, Toxicity Data, and Risk Assessment Methodology: The risk assessment completed in 2005 used 1999 EPA Region IX PRGs as screening values for the identification of COPCs. EPA Region IX revised PRGs in 2004. The new PRGs do not require a re-evaluation of the risk assessment which served as the basis for no further action for the Eastern Briarwood site.

Changes in Exposure Pathways: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the no further action remedy.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question The protectiveness of the remedy?

No.

E. Issues

None.

F. Recommendations and Follow-Up Actions

None.

G. Protectiveness Statement

The decision of no further action selected for the Eastern Briarwood site is protective of human health under a residential exposure scenario and also of the environment. No restrictions are required for the site and the site no longer requires a five-year review.

H. References

AFCEE. 2006 (September). *Final Record of Decision for Groundwater at Eastern Briarwood, Eastern Briarwood, and Storm Drain-5.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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ANG. 1995 (September). *Final Record of Decision for Interim Action Containment of Seven Groundwater Plumes at Massachusetts Military Reservation, Cape Cod, Massachusetts*. Prepared by Stone & Webster, Environmental Technology & Services for ANG MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1994 (August). *Draft Southeast Region Groundwater Operable Unit Remedial Investigation Report (Including Region III)*. Installation Restoration Program, Massachusetts Military Reservation. Prepared by ABB Environmental Services, Inc. for ANG MMR Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.9 Fuel Spill No. 1 (FS-1)

A. Background

A.1. Site Description. The source area for the FS-1 plume (Figure 4-8) is the east and west turnaround areas of the north-south runway on MMR. The FS-1 plume is comprised of two areas of concern: the source area groundwater, which is located on-base and is limited to an area within 1,000 feet of the turnarounds; and a detached groundwater plume, which is located off-base and extends from approximately 2,000 feet downgradient of the source area approximately 2 miles to the Quashnet River. COCs for the source area groundwater are toluene, thallium and lead while the COC for the detached groundwater plume is EDB.

A.2. Initial Responses

CERCLA Actions: In April 1999, AFCEE installed a groundwater ETD system known as the Quashnet and Bogs Pilot Test and Bog Separation Project (Quashnet Pilot System). The pilot treatment system was situated at the leading edge of the plume and consisted of one deep extraction well to capture the deeper portion of the plume and 175 shallow wellpoints (SWPs) to capture EDB contaminated groundwater before it discharged to the Quashnet River bog system. Extracted groundwater was treated with GAC and then discharged into shallow groundwater via an infiltration trench or to the surface waters of the Quashnet bog via a vertical bubbler.

Non-CERCLA Actions: Administrative controls associated with the FS-1 plume include a moratorium on installation of all wells (outside the facility boundary) in areas of groundwater contamination. Workers on-base obtain drinking water from the base water supply system and residences located in the vicinity of the EDB plume have been connected to municipal water supply.

A.3. Basis for Taking Action. The basis for taking action is the result of a risk evaluation conducted for FS-1 as presented in the RI (HAZWRAP 1999a). Future residential exposure to contaminated groundwater present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of $1x10^{-5}$ and the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. The risk assessment also concluded that non-cancer risk thresholds were also exceeded.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and a summary of the remedy implementation at FS-1.

B.1. Regulatory Actions.

1983: An IRP Phase I records search to identify potential sites at MMR indicated the need for further investigation at AOC FS-1.

1985: An initial environmental investigation (Phase II, Stage I study) was performed in the source area. Explorations included eight test pits and one water table well. No contamination was identified.

1989: An SI was performed in the source area. Explorations included 30 soil gas sampling points, one soil boring, and three monitoring wells. Fuel-related compounds were detected in groundwater above MCLs.

1990: An initial RI was performed in which FS-1 was differentiated into two operable units: FS-1B source area and FS-1B downgradient groundwater. Seven source area wells were installed and two source area soil borings were completed. Twelve downgradient wells were installed in two well fences. Four additional water table wells were installed to aid in determination of local groundwater flow. Source area wells contained fuel-related compounds. Of these, only toluene and lead were above MCLs. Downgradient

wells did not contain levels of fuel-related compounds above the MCL. Because of the absence of fuel-related compounds, it was hypothesized that the fuel compounds had degraded.

1993: A base-wide EDB study included collection and analyses of groundwater from seven FS-1 source area wells for EDB. EDB was not detected in the samples.

1995: A Geoprobe investigation was performed to track a potential path of fuel contamination from FS-1. Twenty multilevel locations were sampled for fuel constituents and indicator parameters of biodegradation. Additionally, three new wells were installed and five surface soil samples were collected in the source area. No contamination was identified.

1997–1998: Additional downgradient groundwater and surface water investigations were performed as a result of public comment concerning FS-1. Thirty-two downgradient wells were installed along a path that had not previously been investigated. Thirty-nine surface water samples were collected from the Quashnet River and the Quashnet River bogs. This investigation identified a plume of EDB-contaminated groundwater discharging into the Quashnet River bogs.

1999: The results of the RI (HAZWRAP 1999a) triggered the need for an alternatives analysis in the feasibility study. Alternatives that were retained for detailed analysis in the feasibility study (HAZWRAP 1999b) included Alternative 1 (No Action), Alternative 2B (Limited Action with Leading Edge Extraction, Treatment, and Reinjection/Discharge), Alternative 3 (Axial Well Extraction, Treatment, and Reinjection/Discharge), Alternative 3B (Axial and Leading Edge Extraction, Treatment, and Reinjection/Discharge).

2000: The *Record of Decision Area of Contamination FS-1* (AFCEE 2000) presents a selected alternative to address the contaminated groundwater plume at FS-1. The selected remedial alternative was Alternative 3B (Axial and Leading Edge Extraction,

Treatment, and Reinjection/Discharge). The Proposed Plan (AFCEE 1999) presenting the remedy was issued in June 1999 for public comment. No comments were received.

B.2. Remedial Action Objectives. The RAOs as presented in the ROD (AFCEE 2000a) are as follows:

- prevent or reduce exposure to groundwater COCs exceeding cleanup standards in groundwater;
- restore the aquifer to beneficial uses within a reasonable time frame; and
- prevent or reduce worker, recreational youth, and adult wader contact with Quashnet River water containing unacceptable concentrations of EDB and ingestion of fish exposed to Quashnet River water containing unacceptable concentrations of EDB.

Clean-up standards to achieve RAOs include Federal MCLs, non-zero Federal MCL Goals, MMCLs, or risk-based guidance levels for compounds for which drinking water standards have not been set. For the FS-1 COCs, the cleanup levels are as follows:

Contaminant	Concentration (µg/L)	Standard
EDB	0.02	MMCL
Lead	15	MCL
Thallium	2	MCL
Toluene	1,000	MCL

B.3. Remedy Description. The chosen alternative for FS-1 was Alternative 3B – Axial and Leading Edge Extraction, Treatment and Reinjection/Discharge (AFCEE 2000). In summary, the remedy provides for:

- extracting contaminated groundwater from the contaminant plume and potentially extracting groundwater from hot spot areas identified during remedial design;

- pumping and conveying the extracted groundwater to a treatment system to remove contaminants;
- discharging the treated water back to the groundwater and/or surface water;
- installing monitoring wells, measuring water levels, and sampling groundwater to monitor the performance of the extraction system;
- sampling the influent and effluent of the treatment system to monitor its performance;
- monitoring of source area groundwater for thallium, toluene, and lead;
- restricting groundwater use within the areas contained by the treatment system through imposition of institutional controls; and
- conducting a review after five years of operation to ensure the remedy provides adequate protection of human health and environment.

B.4. Remedy Implementation. Described below is a summary of the implementation of the remedy, which includes system startup and modifications, identified through the analysis of monitoring data and groundwater modeling conducted subsequent to issuance of the ROD. In addition the AFCEE SPEIM program was established to monitor plume changes and ensure effective operation of the AFCEE groundwater remediation systems at MMR. Modifying extraction and reinjection flow rates is an ongoing optimization process based on results of this remedial system performance monitoring.

<u>System Startup</u>: The Quashnet and Bogs Pilot Test and Bog Separation Project began operating in the Quashnet Bog Area in April 1999 as an interim remedy for the FS-1 plume (prior to completion of the ROD). The pilot scale system captured EDB near the leading edge of the FS-1 plume. At startup, the deep extraction well was pumped at 300 gpm and the shallow extraction well points at 450 gpm.

<u>Wellfield Design Report</u>: AFCEE completed the final wellfield design for the FS-1 plume in December 2001 (AFCEE 2001a). The wellfield design was modified from the design as specified in the ROD based on analysis of data collected under SPEIM and groundwater modeling conducted subsequent to issuance of the ROD. The wellfield design specified operation of four deep extraction wells located along the axis of the

plume. It was determined that the shallow well extraction points should be phased out or shut down completely based on the timeliness of the deep extraction wells being brought on-line. All of the treated water should be discharged to surface water through three vertical bubblers.

Shutdown of System: Due to a fire that destroyed the pilot treatment plant in October 2002, the system could no longer be operated. The final treatment system, consisting of four deep extraction wells as specified in the *Final Fuel Spill-1 Wellfield Design Report* (AFCEE 2001b), was constructed and became operational in October 2003.

System Performance: Through December 2007, over 2.7 billion gallons of groundwater have been treated by the FS-1 ETD system, removing approximately 17 lbs of EDB (AFCEE 2008).

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review.

- Final FS-1 ETD System: The final FS-1 ETD system began operating on 20 September 2003. The final ETD system consists of four extraction wells with a combined flow rate of 750 gpm. Extracted groundwater is treated with GAC and discharged to surface water through three vertical bubblers.
- Decommissioning of Shallow Wellpoint System: 155 of the 175 SWPs were decommissioned in January 2004. Twenty SWPs remained as shallow groundwater monitoring points. Operation of the SWP system was not part of the final ETD system because modeling conducted in support of the final wellfield design report (AFCEE 2001b) indicated that most of the EDB mass associated with the leading edge of the plume would be captured by the southern-most deep extraction well and the uncaptured leading edge portion of the FS-1 plume would discharge to the bogs at low or non-detectable concentrations. Monitoring is conducted under the SPEIM program to monitor for EDB in surface water of the Quashnet River and cranberry bogs.
- Monitoring Program: The SPEIM monitoring program was implemented to monitor changes within the plume and identify opportunities for optimization of the FS-1 ETD system. The SPEIM program evaluates hydraulic, chemical, and

plant operational data collected during pre-operation, start-up and continued operation of the FS-1 ETD system.

- Source Area Sampling Optimization: Sampling of source area groundwater monitoring wells for toluene and thallium was discontinued in 2005 because these analytes are either below the MCL or have not been detected in source area groundwater monitoring wells (AFCEE 2005).
- FS-1 ETD System Optimization: The FS-1 ETD system was optimized in October 2007 based upon a review of SPEIM monitoring data collected at FS-1 (AFCEE 2007). This optimization included turning off one extraction well, shortening the effective screen length of an extraction well and adjusting flow rates at the three remaining extraction wells. The combined flow rate for the FS-1 ETD system decreased from 750 gpm to 515 gpm. This optimization was designed in response to reduction in size of the FS-1 plume and focus extraction stresses to that portion of the aquifer characterized by higher EDB concentrations.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3.

The remedial system is functioning as intended by the ROD and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy. Exposure pathways have been reduced by the implementation of institutional controls.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods: There were no changes in risk assessment methodology.

Review of RAOs: The RAOs currently require the Air Force to "prevent or reduce exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long term protectiveness.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations. RAOs should be modified as described in Question B.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008 (March). *Fuel Spill-1 2007 Summary Letter Report*. Prepared by CH2M HILL for AFCEE/MMR Installation Restoration Program. Otis ANG Base, MA.

_____. 2007 (August). *FS-1 ETD System Optimization Project Note.* Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2005 (June). *Final Fuel Spill-1 2004 System Performance and Ecological Impact Monitoring Report*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2001a (December). *Final Fuel Spill-1 Wellfield Design Report*. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2001b (December). *Final Fuel Spill-1 (FS-1) Post- Record of Decision (ROD) Change*. AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2000 Final *Record of Decision, Area of Contamination FS-1*. Prepared by Hazardous Waste Remedial Action Program for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 1999 (June). *Proposed Plan for Groundwater and Surface Water Cleanup Related to FS-1, Massachusetts Military Reservation*.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

HAZWRAP. 1999a Remedial *Investigation Report. Area of Concern FS-1.* Lockheed Martin Energy Systems, Inc., Oakridge, Tennessee.

_____. 1999b Feasibility *Study, Area of Contamination FS-1.* Lockheed Martin Energy Systems, Inc., Oakridge, Tennessee.

4.4.10 Fuel Spill No. 12 (FS-12)

A. Background

A.1. Site Description. The FS-12 plume (Figure 4-9) is located along the eastern boundary of the MMR, northeast of Snake Pond in Sandwich, Massachusetts. The FS-12 groundwater plume consists of fuel-related contaminants and is the result of a release of approximately 70,000 gallons of aviation fuel from a now-abandoned fuel pipeline along Greenway Road, which is located on-base. The FS-12 groundwater plume migrated off the base (i.e., to the south) and under private property. The COCs for the FS-12 plume are EDB and benzene. As of December 2007, benzene is detected only sporadically above the MCL of 5 µg/L at wells located immediately downgradient of the source area. Therefore, the FS-12 plume is defined by groundwater containing EDB at concentrations above the MMCL of 0.02 µg/L.

A.2. Initial Responses. The Greenway Road pipeline was shut down in 1973 and clean-closed in place in 1997 (AFCEE 2000). The source area contamination was addressed by implementing an AS/SVE system as a time-critical removal action. The AS/SVE system operated between October 1995 and February 1998 removing over 44,580 lbs of fuel-related constituents. The source removal was conducted in accordance with the CERCLA time-critical removal action process. A source area removal action summary report has been prepared and approved by the regulatory agencies (AFCEE 2000). Refer to Section 3.2.25 for more details on the FS-12 Source Area.

A.3. Basis for Taking Action. Groundwater contamination associated with FS-12 was first discovered in 1990 when the Sandwich Water District detected hydrocarbon odors in two exploratory wells installed off-base as part of an effort to identify suitable locations for additional water supply production wells. The RI completed in 1993 concluded that fuel, which leaked from the pipeline, contaminated soil and groundwater (HAZWRAP 1995). Free product was found in the vadose zone over an approximately five-acre area at and south of Greenway Road. The FS-12 source area was subsequently defined as an

11-acre area of fuel-contaminated vadose zone soil, groundwater, and floating free product. A dissolved-phase plume containing primarily benzene above the MCL of 5 μg/L and EDB above the MMCL of 0.02 μg/L extended from the source area to approximately 5,000 feet downgradient, under private property.

The basis for taking action is the result of a risk evaluation conducted for FS-12 as presented in the *Final Fuel Spill-12 Groundwater Feasibility Study* (AFCEE 2005b). Future residential exposure to contaminated groundwater present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of $1x10^{-5}$ and the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$. The risk assessment also concluded that non-cancer risk thresholds were also exceeded.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and a summary of the remedy implementation at FS-12.

B.1. Regulatory Actions. The *Record of Decision for Interim Action Containment of Seven Groundwater Plumes*, known as the IROD (ANG 1995), presents the interim remedial action to address contaminated groundwater plumes at MMR. The IROD stated that extraction and treatment would continue until the final remedy for the site is chosen. The interim and final remedies must be consistent with the cleanup goals for the entire MMR site. A detailed description of the development of the FS-12 interim remedy is provided in the ROD (AFCEE 2006a) yet the major components of the interim remedy are also summarized below:

- Extraction of contaminated groundwater from 25 extraction wells, 11 of which are situated at the leading edge to prevent additional downgradient migration of the plume, and 14 of which are situated along the axis of the plume to remove contamination where COCs were the highest.
- Pumping and conveying the extracted groundwater to a treatment system to remove contaminants.

- Discharge of the treated water back to the aquifer through 23 reinjection wells, which are situated downgradient of the extraction toe fence (leading edge) and west of the axial fence along the eastern shore of Snake Pond.
- Installation of monitoring wells, measuring water levels, and sampling groundwater to monitor the performance of the extraction system.
- Sampling of the influent and effluent of the treatment system to monitor its performance.
- Restricting groundwater use within the areas contained by the ETR through imposition of institutional controls.
- Conducting a review after five years of operation to ensure the remedy provides adequate protection of human health and environment.

A risk assessment was completed in 2005 using system performance and plume data collected to characterize the plume and assess potential risks from exposure to groundwater in the FS-12 plume area. Based on the risk assessment, RAOs were established, which formed the basis of a feasibility study. The feasibility study evaluated a range of remedial alternatives, one of which has been selected as the final remedy (AFCEE 2005b).

The *Final Record of Decision for Fuel Spill-12 Groundwater* (AFCEE 2006a) presents the selected alternative to address the contaminated groundwater plume at FS-12. The selected remedial alternative was Alternative 3, which calls for continued operation of the existing FS-12 ETR system. The selected remedy leaves open the possibility of modifying the ETR system for optimization purposes including installation of packers, shutting off wells, adjusting flow rates or installing new extraction wells if deemed necessary. The Proposed Plan (AFCEE 2005a) presenting the remedy was issued in September 2005 for public comment. No significant changes to the proposed remedy, as it was presented in the Proposed Plan, were identified from comments received (AFCEE 2006a).

B.2. Remedial Action Objectives.

The RAOs as presented in the ROD (AFCEE 2006) are as follows:

- Prevent or reduce residential exposure to FS-12 groundwater with benzene concentrations greater than the MCL of 5 µg/L
- Prevent or reduce residential exposure to FS-12 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L.
- Return useable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

The groundwater cleanup levels as specified in the RAOs are the MCL for benzene (5 µg/L) and the MMCL for EDB (0.02 µg/L).

B.3. Remedy Description. The FS-12 ETR system design initially consisted of a network of 30 extraction wells pumping at a design rate of 830 gpm and 30 reinjection wells. The computer modeling that provided the basis for that network was described in the *Plume Containment Design I Modeling Report* (OpTech 1996).

The original major components of the ETR system at FS-12 included:

- extraction of contaminated groundwater and transfer of the groundwater from the extraction wells through double-walled high-density polyethylene pipe to an influent (equalization) tank;
- pH adjustment of influent;
- greensand filters to remove suspended solids, iron, and manganese;
- solids settling and collection facilities;
- ultraviolet light/oxidation (UV/OX) system to oxidize organics (i.e., EDB and benzene)
- GAC system to reduce the organic contaminant concentrations to below detection limits;
- return of the treated water to the aquifer through reinjection wells situated between the axial extraction wells and Snake Pond and downgradient of the southern toe extraction fence

B.4. Remedy Implementation. Described below is a summary of the remedy, which includes system startup and modifications as a result of the analysis of monitoring data collected under the SPEIM program and groundwater modeling. Only major modifications are described below. Modification of extraction and reinjection flow rates is an ongoing optimization process based on results of remedial system performance monitoring conducted by AFCEE.

System Startup: Startup began in September 1997. At that time, the FS-12 ETR system pumped 772 gpm from the aquifer using 25 extraction wells and returned the treated water to the aquifer via 23 reinjection wells.

System Modification: In November 1997, the UV/OX system taken off-line because concentrations of contaminants were not high enough to warrant its use.

Ecological Monitoring: Based on the FS-12 ecological impact monitoring results showing negligible impact, ecological monitoring is no longer required. Approval granted by regulatory agencies in December 1999.

Additional EDB Contamination: AFCEE modified the existing ETR system to address a zone of EDB located to the west of the main FS-12 plume in December 2000. An existing reinjection well (90RIW0010) was converted into an extraction well (90EW0031) in June 2001. The total flow rate at that time was 688 gpm (AFCEE 2002).

System Performance: Through December 2007, over 3.6 billion gallons of groundwater have been treated by the FS-12 ETR system, removing approximately 190 lbs of COCs (AFCEE 2008).

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review.

- A Final Fuel Spill-12 Groundwater Feasibility Study was completed in 2005 (AFCEE 2005b).

- A Proposed Plan was completed in 2005 (AFCEE 2005a).
- A Final Record of Decision for Fuel Spill-12 Groundwater was completed in 2006 (AFCEE 2006a).
- Delineation of EDB identified between the main FS-12 plume and Snake Pond (AFCEE 2004, 2005c)
- ETR system optimizations in 2005 and 2006 to focus extraction stress to portions of the aquifer characterized by highest EDB concentrations (AFCEE 2005b, 2006b). The optimizations included turning off extraction wells in the northern (trailing edge) portion of the plume and shortening the effective screen lengths of extraction wells within the core areas of the plume. As of December 2007, 10 extraction wells and 22 reinjection wells are operating at a total flow rate of 545 gpm.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3. The remedial system is functioning as intended by the ROD and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: There have been no changes in standards or TBC guidance.

Changes in Exposure Pathways: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods: There were no changes in risk assessment methodology.

Review of RAOs: The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long term protectiveness.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations. RAOs should be modified as described in Question B.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008 (March). *Fuel Spill-12 2007 Summary Letter Report*. Prepared by CH2M HILL for AFCEE/MMR Installation Restoration Program. Otis ANG Base, MA.

_____. 2006a (September). *Final Record of Decision for Fuel Spill-12 Groundwater.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program. Otis ANG Base, MA.

_____. 2006b (November). Project Note: *FS-12 Monitoring Network and Extraction Treatment and Reinjection System Optimization*. Prepared by CH2M HILL for AFCEE MMR Installation Restoration Program. Otis ANG Base, MA.

_____. 2005a (October). *Proposed Plan for Groundwater at Fuel Spill-12 (FS-12)*. Fact Sheet 2005-10. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2005b (September). *Final Fuel Spill-12 Groundwater Feasibility Study.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2005c (March). *Final Fuel-Spill-12 2005 Optimization Technical Memorandum*. Prepared by CH2M HILL for AFCEE/MMR Installation Restoration Program. Otis ANG Base, MA.

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_____. 2002 (November). *Final Fuel Spill-12 Treatment System 2001 Annual System Performance and Ecological Impact Monitoring Report*. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2000 (May). *Final Fuel Spill-12 Phase II Technical Memorandum*. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

ANG. 1995 (September). *Final Record of Decision for Interim Action Containment of Seven Groundwater Plumes at MMR, Cape Cod, MA.* Prepared by Stone & Webster Environmental Technology & Services for ANG Readiness Center, Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

HAZWRAP. 1995 (January). *Remedial Investigation Report. FS-12 Study Area.* Three Volumes. Prepared by Hazardous Waste Remedial Action Program for ANG Readiness Center, Installation Restoration Program, Otis ANG Base, MA.

OpTech. 1996 (August). *Installation Restoration Program, Plume Containment Design Groundwater Modeling Report, Massachusetts Military Reservation*.

4.4.11 Fuel Spill No. 13 (FS-13) Groundwater

A. Background

A.1. Site Description. The FS-13 plume consisted of fuel-related contaminants located within the footprint of the CS-10 plume. The source of this contamination is a fuel spill suspected to have occurred in 1972. The spill site is near the rotary at the east end of Connery Avenue. The COCs for the FS-13 plume are 1,2,4-TMB and 1,3,5-TMB (AFCEE 1999b). In 1997, a drilling and sampling program was conducted to better define the plume. The investigation showed that the groundwater contamination from FS-13 had not spread significantly beyond the FS-13 source area. The plume does not discharge to surface water and has not migrated off-post.

A.2. Initial Responses. None

A.3. Basis for Taking Action. The FS-13 plume is a component of the SWOU, which also includes the CS-4 plume, CS-20 plume, FS-21 plume, FS-28 plume, and FS-29 plume. Based on site characterization activities conducted for the SWOU RI (AFCEE 1999a), 1,2,4-TMB and 1,3,5-TMB have been identified as primary contaminants.

B. Remedial Actions

This section presents the regulatory actions, RAOs, and remedy description for the FS-13 plume.

B.1. Regulatory Actions. The Final ROD for the CS-4, CS-20, CS-21, and FS-13 plumes (AFCEE 2000) is the controlling document for the FS-13 plume. The selected remedy for the FS-13 plume is Limited Action and Institutional Controls. The remedy (Alternative Two) was selected from the analysis of alternatives presented in the SWOU Feasibility Study (AFCEE 1999b).

B.2. Remedial Action Objectives

Remedial Action Objectives to protect human health as presented in the ROD (AFCEE 2000) are:

- Prevent or reduce residential exposure to 1,2,4-TMB and 1,3,5-TMB exceeding 17 µg/L in groundwater.
- Restore the aquifer to its beneficial uses within a reasonable timeframe.

Table B-1
COCs and RALs for FS-13 Plume

COC	Basis	Concentration (µg/L)	Standard
1,2,4-TMB	Calculated HI=1	17	None
1,3,5-TMB	Calculated HI=1	17	None

B.3. Remedy Description. The selected remedy has three components:

- Long-term groundwater monitoring.
- Institutional controls to prevent the use of groundwater contaminated with FS-13 plume contaminants.
- Additional institutional controls to prevent the use of contaminated groundwater in the event that the land above the FS-13 plume is sold or transferred while unacceptable concentrations of contaminants remain.

B.4. Remedy Implementation. LTM of the plume indicates the plume contaminants are not mobile and have not migrated (AFCEE 2005).

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review:

- Long-Term Monitoring Data Transmittal (Annual Report), November 2003 (AFCEE 2004);
- Long-Term Monitoring Data Transmittal (Annual Report), November 2004 (AFCEE 2005).
- A Draft ESD was submitted in March 2007 to document changes to the selected remedies for CS-4, CS-20, and FS-29 which are other SWOU plumes (AFCEE 2007). Since the draft submittal, the ESD has been modified during the comment resolution process to include CS-21, FS-13, and FS-28. The ESD, which will be finalized in September 2008, will update the LUC language for FS-13 as described in Section 4.3.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the remedy has been implemented and is functioning as intended by the ROD.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Changes in Standards and To-Be Considered: MassDEP regulates TMB as C_{11}-C_{22} aromatic hydrocarbons. The MassDEP GW-1 standard is 200 µg/L. The exposure assumptions are conservative. The calculated cleanup levels for TMBs are based on a residential exposure scenario. Since the cleanup standards in the ROD (17 µg/L) are more stringent than the current MassDEP GW-1 standard, the change in standards does not affect protectiveness.

Changes in Exposure Pathways: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes in the toxicity factors for COCs.

Changes in Risk Assessment Methods: There were no changes in risk assessment methodology.

Review of RAOs: The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long term protectiveness.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

There is no other information that questions the protectiveness of the remedy.

E. Issues/Recommendations and Follow-Up Actions

RAOs should be modified as described in Question B.

F. Protectiveness Statement

The remedy for FS-13 groundwater as modified in the September 2008 ESD (simultaneously published with this five-year review) is expected to be protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

H. References

AFCEE. 2007 (March). *Draft Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, and Fuel Spill-29 Groundwater Plumes.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

———. 2005 (January). *Fuel Spill-13 Long-Term Monitoring Data Transmittal – November 2004 Results*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis Air National Guard Base, MA

______. 2004 (January). *Fuel Spill-13 Long-Term Monitoring Data Submittal – November 2003.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

______. 2003 (April). *Comprehensive Long-Term Monitoring Plan, Version 3.2.* Prepared by Jacobs Engineering Group for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

______. 2000 (February). *Final Record of Decision for the CS-4, CS-20, CS-21, and FS-13 Plumes.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

______. 1999a. (June). C*omprehensive Final Southwest Operable Unit Remedial Investigation*. Prepared by Jacobs Engineering Group for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1999b. (May). *Final Southwest Operable Unit Feasibility Study*. Prepared by Jacobs Engineering Group for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.12 Fuel Spill No. 28 (FS-28) Groundwater

A. Background

A.1. Site Description. The FS-28 plume (Figure 4-10) was first discovered in 1993 beneath the leading edge of the CS-4 plume and was subsequently investigated as a separate groundwater plume. The investigations found EDB to be upwelling into the Coonamessett River in Falmouth in 1996. The COC in the FS-28 plume is EDB. The MMCL for EDB is 0.02 µg/L. The FS-28 source area has not been identified, and thus the plume cannot be traced back to a specific area on MMR. It is speculated that EDB entered the groundwater from fuel spills.

The FS-28 plume extends from the area south of Route 151 near Boxberry Hill Road, flows under the western portion of Coonamessett Pond, and extends to the cranberry bogs surrounding the Coonamessett River; a deep leading edge portion of the plume extends as far south as Pond 14. The highest concentrations of EDB in the FS-28 plume are found in the vicinity of extraction well 69EW0001, with concentrations generally decreasing to the north. Two recently characterized leading edge lobes have been delineated to the south of extraction well 69EW0001 (AFCEE 2008, 2007, 2006). The EDB concentrations in these leading edge lobes are generally lower than those seen to the north near 69EW0001.

A.2. Initial Responses.

<u>Non-CERCLA Actions</u>: In 1996, AFCEE completed construction of a wellhead carbon filtration system for the Coonamessett Water Supply Well (CWSW) as a precaution, even though this well has never been affected by the FS-28 plume. This wellhead carbon filtration system was subsequently dismantled in 2004 when water from CWSW was connected to the Crooked Pond treatment facility.

In 1997 and 1998, in an effort to protect public health and eliminate the threat of EDB in private wells near homes above and/or near the FS-28 plume, AFCEE installed town water mains and piping to 207 residents of Hatchville. Ten irrigation wells were also installed for cranberry growers along the river system to replace their previous use of surface water. Growers were compensated for their 1997, 1998, and 1999 crops.

CERCLA Actions: AFCEE installed an ETD system in 1997 under the CERCLA time-critical removal action process to capture the majority of the plume mass at Hatchville Road and to minimize upwelling into the Coonamessett River System. In April 1999, AFCEE implemented a non-time-critical removal action which added additional extraction capacity to the system in the form of SWPs in an attempt to capture EDB contaminated groundwater prior to its discharge to the Coonamessett River and neighboring cranberry bogs. Installation of this SWP system has generally been successful in improving water quality in the river and bogs.

A.3. Basis for Taking Action. The basis for taking action is detected concentrations of EDB and risk assessment results of the SWOU RI (AFCEE 1999). The baseline cancer risk calculations in the SWOU RI indicated that unless remedial action is undertaken, future residential exposure to contaminated groundwater may present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of 1×10^{-5} and the acceptable EPA range of 1×10^{-4} to 1×10^{-6}.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and remedy implementation for the FS-28 plume.

B.1. Regulatory Actions. A feasibility study was completed in 2000 (AFCEE 2000c). Four of seven alternatives were retained for alternatives analysis. A Proposed Plan was released to the public in February 2000 (AFCEE 2000b) to solicit comments on the preferred alternative (Alternative 7). The remedy selected and documented in the ROD (AFCEE 2000a) was Alternative 3 (i.e., continue treatment system operations).

B.2. Remedial Action Objectives. The RAOs presented in the ROD (AFCEE 2000c) are the following:

- Prevent or reduce residential exposure to EDB exceeding 0.02 µg/L in groundwater.
- Restore the aquifer to its beneficial uses within a reasonable time.
- Prevent worker contact and child and adult wader contact with Coonamessett River water containing unacceptable concentrations of EDB.
- Prevent or reduce ingestion of fish exposed to Coonamessett River water containing unacceptable concentrations of EDB

B.3. Remedy Description. The selected remedy in the ROD (AFCEE 2000a) included the following components:

- Continued operation of the existing FS-28 ETD system including the 204 SWP extraction system and the CWSW wellhead treatment system. Extracted water would be treated with GAC. Contaminants would be destroyed during carbon reactivation. Treated water could be used, if necessary for cranberry operations in the upper bogs. Berms and vinyl sheet piles would separate cranberry bogs from the river.
- Continue to supply uncontaminated water to the agricultural users on the Coonamessett River.
- Institutional controls mitigate exposure to humans from EDB-contaminated groundwater. In 1999, the Falmouth BOH adopted water well regulations to minimize the risk of exposure to groundwater contamination.
- Engineering controls are in place to mitigate exposure to humans from EDB-contaminated groundwater. Residents potentially impacted by the plume are connected to a public water supply.
- Monitoring of the plume and performance monitoring of the treatment systems. Ecological sampling would also be conducted as part of this alternative. The focus of ecological sampling is to measure the impact that treatment systems (not the plume) have on the environment.

B.4. Remedy Implementation. The existing FS-28 ETD system has been in place since September 1997 with modifications in April 1999 and December 2007. The ETD system was designed to treat a maximum of 750 gpm. At the time of system startup in October 1997, the ETD system consisted of one extraction well (69EW0001) with the goal of

remediating the northern portion of the plume. In April 1999, the remedial system was expanded with the startup of the SWP system which consists of an array of 204 wellpoints located to the south of 69EW0001. The SWP system was installed to intercept shallow EDB-contaminated groundwater before it discharged to the Coonamessett River or associated cranberry bogs. During 2007, the FS-28 ETD system was further expanded through the installation of a second extraction well (69EW0002) to remediate the newly characterized deeper leading edge lobe of the plume identified to the south of both 69EW0001 and the SWP system (AFCEE 2008). As of July 2008, the FS-28 ETD system is operating at a total flow rate of 700 gpm; 550 gpm is being extracted at 69EW0001, 50 gpm at 69EW0002, and 100 gpm from the SWP system where 19 of the 204 SWPs are operating. Based on data through December 2007, the ETD system has treated 3,688 million gallons and has removed 13.4 lbs of EDB (AFCEE 2008).

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review.

- The leading edge lobe of the FS-28 plume was characterized between 2004 and 2007 (AFCEE 2008, 2007, 2004).
- During 2007, the FS-28 ETD system was further expanded through the installation of a second extraction well (69EW0002) to remediate a deeper leading edge lobe of the plume identified to the south of both 69EW0001 and the SWP system (AFCEE 2008). As of June 2008, the FS-28 ETD system is currently operating at a total flow rate of 700 gpm; 550 gpm is being extracted at 69EW0001, 50 gpm at 69EW0002, and 100 gpm from the SWP system where 19 of the 204 SWPs are operating.
- EDB was detected below its MMCL in surface water contained within a Coonamessett River cranberry bog ditch in the summer of 2005. Subsequent sampling in this area has been nondetect for EDB.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA

guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3.

The remedial system is functioning as intended by the ROD and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented and provided the information necessary for the system modification described in Sections B.4 and C.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: There have been no changes in standards or TBC guidance.

<u>Changes in Exposure Pathways</u>: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: There have been no changes in the toxicity factors for COCs.

<u>Changes in Risk Assessment Methods</u>: There were no changes in risk assessment methodology.

<u>Review of RAOs</u>: The RAOs currently require the Air Force to “prevent or reduce residential exposure.” This RAO should be modified to eliminate the word “reduce” to better ensure long term protectiveness.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations. RAOs should be modified as described in Question B.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008 (March). *Fuel Spill-28 2007 Summary Letter Report.* Prepared by CH2M HILL for the AFCEE/MMR, IRP Otis ANG Base, MA.

_____. 2007 (February). *Fuel Spill-28 2006 Summary Letter Report.* Prepared by CH2M HILL for the AFCEE/MMR, IRP Otis ANG Base, MA.

_____. 2006 (September). *Final Fuel Spill-28 2005 Plume Update Technical Memorandum.* Prepared by CH2M HILL for the AFCEE/MMR, IRP Otis ANG Base, MA.

_____. 2000a (October). *Final Record of Decision for the Fuel Spill-28 and Fuel Spill-29 Plumes.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2000b (February). *Final Proposed Plan for the Fuel Spill-28 and Fuel Spill-29 Plumes in the Southwest Operable Unit.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2000c (January). *Final FS-28 and FS-29 Groundwater Feasibility Study.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 1999 (May). *Final Southwest Operable Unit Remedial Investigation.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.13 Fuel Spill No. 29 (FS-29) Groundwater

A. Background

A.1. Site Description. The FS-29 plume (Figure 4-11) is a component of the SWOU. The FS-29 plume is detached from its source area, the location of which is unknown. The COCs for the FS-29 plume are EDB and CCl_4.

A.2. Initial Responses.

Non-CERCLA Actions: In 1999, the Falmouth BOH adopted water well regulations to minimize the risk of exposure to groundwater contamination. Furthermore, residents potentially impacted by the plume are connected to a public water supply.

A.3. Basis for Taking Action. The basis for taking action is the presence of EDB and CCl_4 greater than their MMCL and MCL, respectively, and the results of the risk assessment presented in the SWOU RI (AFCEE 1999). The baseline cancer risk calculations in the SWOU RI indicated that unless remedial action is undertaken, future residential exposure to contaminated groundwater may present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of $1x10^{-5}$ and the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and remedy implementation for the FS-29 plume.

B.1. Regulatory Actions. A feasibility study was completed in 2000 (AFCEE 2000c). Four of seven alternatives were retained for alternatives analysis. A Proposed Plan was released to the public in February 2000 (AFCEE 2000b) to solicit comments on the preferred alternative. The selected remedy was documented in the ROD for the FS-28 and FS-29 plumes (AFCEE 2000a).

B.2. Remedial Action Objectives. The RAOs presented in the ROD (AFCEE 2000a) are as follows:

- Prevent or reduce residential exposure to EDB exceeding 0.02 µg/L and CCl_4 exceeding 5 µg/L in groundwater.
- Restore the aquifer to its beneficial uses within a reasonable time.

B.3. Remedy Description. The selected remedy for the FS-29 plume is Alternative 3 which includes design, construction, and operation of an ETI system to hydraulically capture and treat plume contaminants. Because RI data was limited, the alternative also required additional sampling and analysis for plume delineation. The selected remedy as presented in the ROD consisted of extracting 600 gpm of groundwater through two extraction wells, processing the influent through greensand filters and GAC, and discharging the water into an infiltration trench. Alternative 3 also included institutional controls to mitigate exposure to humans from contaminated groundwater. Institutional controls in place include connection of residents to the municipal water supply (Falmouth) and well installation regulations administered by the Falmouth BOH. For the portion of the plume underneath the Crane Wildlife Refuge, the Massachusetts water supply permitting process mitigates exposure of the public to contaminated groundwater.

AFCEE performed a pre-design data gap investigation in 2001 to support construction of the remedy. The pre-design data gap investigation in 2001 is documented in the FS-29 plume technical memorandum (AFCEE 2002).

The Southwest plumes remedial system was designed and installed to collectively remediate the CS-4, CS-20, CS-21, and FS-29 groundwater plumes (AFCEE 2004). The contaminated groundwater is captured by extraction wells in each plume, treated in a centrally located treatment plant, the HATF, and the treated water is returned to the aquifer through reinjection wells, an infiltration trench, and an infiltration gallery.

The two FS-29 extraction wells were installed as described in the *Final CS-4, CS-20, CS-21, and FS-29 Wellfield Design Report* (AFCEE 2004). A Draft ESD was submitted in March 2007 to document changes to the selected remedies for CS-4, CS-20, and FS-29 (AFCEE 2007). The primary difference between the cleanup strategy identified in the ROD and the current design is that the selected alternative presented in the ROD anticipated that all of the groundwater within the FS-29 plume would be captured by the remedial system; however, the final design will allow the groundwater contamination in the downgradient leading edge of FS-29 to reach cleanup levels through natural attenuation instead of through active remediation. While analyzing various designs for system performance, effectiveness, property access issues, and other constraints, the final design for FS-29 was developed to meet the RAOs while allowing for a relatively small portion of the plume to attenuate naturally. The ESD language has been finalized and distribution of the final, signed ESD is scheduled for the summer of 2008.

B.4. Remedy Implementation. Institutional and engineering controls are in place to mitigate exposure to humans from contaminated groundwater. The FS-29 remedial system began operation on 11 September 2006 at a flow rate of 525 gpm. The FS-29 remedial system has treated approximately 347 million gallons of groundwater and has removed approximately 5 lbs of COCs through December 2007 (AFCEE 2008).

C. Progress Since the Last Five-Year Review

The following activities were conducted/observed since the last review:

- Southwest Plumes Wellfield Design completed in August 2004 (AFCEE 2004).
- As part of Phase II of the Southwest plume system startup, the FS-29 remedial system began operation on 11 September 2006 at a flow rate of 525 gpm.
- The FS-29 remedial system was optimized in March 2008, reducing the flow rate from its two extractions wells to a total of 373 gpm.
- The Draft Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, and Fuel Spill-29 Groundwater Plumes was submitted in March 2007 and comment resolution reached in July 2008.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3. The remedial system is functioning as intended by the ROD and ESD and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: There have been no changes in standards or TBC guidance.

<u>Changes in Exposure Pathways</u>: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: There have been no changes in the toxicity factors for COCs.

<u>Changes in Risk Assessment Methods</u>: There were no changes in risk assessment methodology.

Review of RAOs: The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long term protectiveness.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations. RAOs should be modified as described in Question B.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008 (March). *Southwest Plumes 2007 Summary Letter Report.* Prepared by CH2M HILL for AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2007 (March). *Draft Explanation of Significant Differences for Chemical Spill-4, Chemical Spill-20, and Fuel Spill-29 Groundwater Plumes.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2004 (August). *Final Chemical Spill-4, Chemical Spill-20, Chemical Spill-21, and Fuel Spill-29 Wellfield Design Report.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2002 (October). Fuel *Spill-29 Plume Technical Memorandum.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2000a (October). *Final Record of Decision for the Fuel Spill-28 and Fuel Spill-29 Plumes.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2000b (February). *Final Proposed Plan for the Fuel Spill-28 and Fuel Spill-29 Plumes in the Southwest Operable Unit.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 2000c (January). *Final FS-28 and FS-29 Groundwater Feasibility Study.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

_____. 1999 (May). *Final Southwest Operable Unit Remedial Investigation.* Prepared by Jacobs Engineering Group Inc., for the AFCEE/MMR IRP, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.14 Landfill No. 1 (LF-1) Groundwater

A. Background

A.1. Site Description. The LF-1 plume (Figure 4-12) originated from the Main Base Landfill (LF-1 Landfill) and from a former motor pool located immediately to the southeast of the landfill, designated as CS-9. Investigations to characterize the LF-1 plume began in 1988 (E.C. Jordan Co. 1990). The plume extends from the base landfill located on Connery Avenue off base to Red Brook and Squeteague harbors. The COCs for the LF-1 plume are defined in Section A.3.

A.2. Initial Responses. Three cells of the LF-1 landfill were capped in 1995. Capping the landfill cells eliminated the infiltration of rainwater thereby reducing the movement of contaminants from the landfill to the groundwater. The cap covers approximately 60 acres of the former landfill site and consists of several layers, including a geo-synthetic clay liner, a geo-membrane, sand, and vegetation to prevent erosion. The three older cells, referred to as the NWOU would be monitored (ANG 1995). The review of the landfill can be found in Section 3.2.31.

CS-9 contaminated soils and underground drainage structures were removed during the summer of 1994 as part of the LF-1 landfill capping project (AFCEE 2002). The review of CS-9 can be found in Section 2.0.

A.3. Basis for Taking Action. An RI was completed in 1996 (AFCEE 1996) to determine the nature and extent of groundwater contamination resulting from past disposal practices at the landfill. Human health and ERAs were conducted as part of the RI. In addition, the risk assessment was updated in 2006 and is presented in the feasibility study (AFCEE 2006c). The risk assessment concluded that future residential exposure to contaminated groundwater at LF-1 present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of $1x10^{-5}$ and the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$.

A Final ROD for the LF-1 source area and groundwater was issued in September 2007 (AFCEE 2007) and defined the plume COCs with their applicable cleanup levels as follows:

Contaminant	Concentration (µg/L)	Standard
PCE	5	MCL
TCE	5	MCL
CCl_4	5	MCL
1,1,2,2-TeCA	2	MassDEP MCP GW-1
Vinyl Chloride (VC)	2	Fed MCL
1,4-Dichlorobenzene (1,4-DCB)	5	MMCL
EDB	0.02	MMCL
Manganese	300	HA

Note: Fed MCL = Federal Maximum Contaminant Level; MCP GW-1 – Massachusetts Contingency Plan Method 1 Groundwater-1 standard; MMCL = Massachusetts MCL; HA = health advisory

B. Remedial Actions

This section presents the regulatory actions, remedial action objectives (RAOs), remedy description, and implemented remedy for the LF-1 plume.

B.1. Regulatory Actions

As stated in the IROD (ANG 1995), the interim remedial action for the seven plumes was designed to intercept the contaminated groundwater plumes to prevent further downgradient migration of the contaminants. The IROD stated that extraction and treatment will continue until the final remedy for the site is chosen. A final remedy was chosen and is documented in the LF-1 ROD (AFCEE 2007).

In summary, the final remedy as outlined in the ROD provides for:

- extracting contaminated groundwater at the base boundary, treating it with GAC and discharging the treated water back to the groundwater and/or other beneficial use;
- monitoring natural attenuation for the plume downgradient of the extraction wells;
- installing monitoring wells, measuring water levels, and sampling groundwater to monitor the performance of the extraction system;
- sampling the influent and effluent of the treatment system to monitor its performance;
- restricting groundwater use within the areas delineated as a plume imposition of LUCs;
- implementing the Bourne Water Provision (i.e., replacing Bourne Public Water Supply Wells #2 and #5); and,
- conducting a review after five years of operation to ensure the remedy provides adequate protection of human health and environment.

B.2. Remedial Action Objectives. The RAOs presented in the ROD (AFCEE 2007) are as follows:

- Prevent the leaching from the source area of landfill contamination that would cause groundwater downgradient from the landfill to be unusable;
- Prevent risks to human health and the environment (if any) posed by the landfill;
- Prevent residential exposure to LF-1 groundwater with TCE concentrations greater than the MCL of 5 µg/L;
- Prevent residential exposure to LF-1 groundwater with PCE concentrations greater than the MCL of 5 µg/L;
- Prevent residential exposure to LF-1 groundwater with CCl_4 concentrations greater than the MCL of 5 µg/L;
- Prevent residential exposure to LF-1 groundwater with 1,1,2,2-TeCA concentrations greater than the Massachusetts GW-1 standard of 2 µg/L;
- Prevent residential exposure to LF-1 groundwater with VC concentrations greater than the MCL of 2 µg/L;
- Prevent residential exposure to LF-1 groundwater with EDB concentrations greater than the MMCL of 0.02 µg/L;

- Prevent residential exposure to LF-1 groundwater with 1,4-DCB concentrations greater than the MMCL of 5 µg/L;
- Prevent residential exposure to LF-1 groundwater with manganese concentrations greater than the HA of 300 µg/L;
- Return usable groundwaters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site; and
- Prevent exposure to LF-1 groundwater for human receptors under non-residential use scenarios (including dermal contact, ingestion, and inhalation), unless shown that such use does not present a carcinogenic risk in excess of the EPA target risk range of 10^{-4} to 10^{-6} or present a non-carcinogenic hazard index greater than 1.0.

B.3. Remedy Description. The selected remedy for the LF-1 source area and groundwater plume is documented in the ROD (AFCEE 2007). The selected remedy for the source area is described in Section 3.2.31. The selected remedy for the LF-1 groundwater provides for continued active treatment of the LF-1 plume with the existing treatment system with an expansion of the system to improve capture of the southern lobe at the base boundary. The objective of this remedy is to continue to operate, maintain, and optimize the existing expanded system to expedite aquifer restoration, maintain containment of the plume upgradient of a point approximately 800 feet west of the base boundary, and implement LUCs to reduce residential exposure to the LF-1 plume. The remedy will also provide for chemical and hydraulic monitoring of the plume as long as active remediation continues. After active treatment becomes no longer effective at expediting plume cleanup, the system will be shut down and the residual plume contamination will continue to be monitored until the RAOs are met. The remedy also provides for monitoring the natural attenuation of the plume downgradient of the extraction wells. In addition, the Bourne Water Provision and LUCs will be implemented and five-year reviews will continue to be performed to determine if the remedy is still appropriate and protective. A residual risk assessment and/or evaluation of the technical and economic feasibility of additional remediation to approach background concentrations will be performed if necessary.

B.4. Remedy Implementation.

Active Treatment System: The original treatment system began operation on 26 August 1999 and consisted of five extraction wells pumping at 700 gpm. The extracted groundwater was transferred to a treatment plant where GAC was used to remove the contaminants. The treated water was then returned to the aquifer through an infiltration gallery and two infiltration trenches. In 2006 the treatment system was modified to add an additional extraction well on the southern edge of the plume to address higher PCE concentrations that were migrating outside of the five-well capture zone. This new extraction well was constructed at the same time as the CS-23 treatment system (see Section 4.4.7). The flow from the new LF-1 extraction (27EW0006, 350 gpm) and from an existing LF-1 extraction well (27EW0002, 300 gpm) is combined with the flow from the two new CS-23 extraction wells (27EW0007, 350 gpm and 27EW0008, 350 gpm) and sent to the HATF where the water is treated using GAC and returned to the aquifer through two infiltration trenches. The LF-1 treatment plant currently treats 595 gpm from four extraction wells. In February 2008, a reinjection well was installed as a replacement for the failing infiltration gallery. Currently the total flow (595 gpm) from the LF-1 treatment system is returned to the aquifer through the reinjection well. During the irrigation months, the flow is partially diverted to send treated water to the Veterans Administration cemetery for irrigation purposes. Through December 2007, over 3.1 billion gallons of groundwater had been treated, removing over 342 lbs of COCs (AFCEE 2008c).

System Performance and Ecological Impact Monitoring: chemical and hydraulic monitoring program has been in place for the LF-1 plume. Monitoring is performed to assess changes in the plume and evaluate the effectiveness of the treatment system. The monitoring network is periodically optimized as the plume or requirements change. In addition, a separate monitoring program has been implemented to identify impacts to neighboring ecosystems. Specifically, surface water levels, vegetation surveys, and amphibian surveys are conducted at Vernal Pool #651 and Spectacle Wetland. Modeling performed for the combined LF-1 and CS-23 systems suggested there could be negative

impacts via drawdown on these wetland area. Field data suggests there are negative impacts; however, additional data is needed to confirm the degree of the impacts.

Monitored Natural Attenuation: LTM is performed for natural attenuation of the western portion of the LF-1 plume (i.e., downgradient of the extraction wells).

Bourne Public Water Supply Well Monitoring: Six monitoring wells, located upgradient of the Bourne Public Water Supply Wells #2 and #5, are sampled quarterly to ensure that LF-1 plume constituents are not threatening these public wells. Analytical results collected to-date did not identify any contaminants above the drinking water standards (AFCEE 2008b).

LUCs: Monitoring of residential wells located within the present or potential path of the LF-1 plume begun in 1996 to ensure that no plume constituents are present in private water supplies. The majority of residents have been connected to public water. Additional evaluation of residential wells will continue under the LUCs program (see Section 4.3).

C. Progress Since the Last Five-Year Review

The activities conducted/observed since the last review are described in the following documents:

- Final Landfill-1 Source Area and Groundwater Feasibility Study (AFCEE 2006c)
- Final Chemical Spill-23 Wellfield Design Report (AFCEE 2006a)
- A Proposed Plan was completed in 2006 (AFCEE 2006b)
- Final Record of Decision for Landfill-1 Source Area and Groundwater (AFCEE 2007)
- Final Interim Remedial Action Report (AFCEE 2008a)
- Treatment system modification; addition of one extraction well: Startup in December 2006 (AFCEE 2006a, 2008c)
- Treatment system modification; replacement of infiltration gallery with reinjection well (AFCEE 2008c).

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater in the long term have not yet been fully implemented. See Section 4.3 for a further discussion.

The remedial system is functioning as intended by the ROD and is expected to achieve cleanup levels. Operational costs are appropriate for the remedy and a robust optimization program continues to reduce future costs. Monitoring and evaluation activities are continual and well-documented and have indicated excessive drawdown of surface water at a nearby wetland and vernal pool (AFCEE 2008c).

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

<u>Changes in Standards and To Be Considered</u>: There have been no changes in standards or TBC guidance.

<u>Changes in Exposure Pathways</u>: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

<u>Changes in Toxicity and Other Contaminant Characteristics</u>: There have been no changes in the toxicity factors for COCs.

<u>Changes in Risk Assessment Methods</u>: There were no changes in risk assessment methodology.

<u>Review of RAOs</u>: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up Actions

See Section 4.3 for a full discussion of the LUC issue and recommendations. The Air Force will continue to monitor the wetland and vernal pool near LF-1/CS-23 for potential negative ecological impacts associated with the surface water drawdown.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2008a (August). *Final Interim Remedial Action Report*. Prepared by ECC for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

______. 2008b (March). *LF-1/CS-23 2007 Summary Letter Report*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2008c (February). *Draft Landfill-1/Chemical Spill-23 2007 Plume Update Technical Memorandum*. Prepared by CH2M HILL for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2007 (September). *Final Record of Decision for Landfill-1 Source Area and Groundwater.* Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2006a (August). *Final Chemical Spill-23 Wellfield Design Report*. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA. August, 2006.

_____. 2006b (June). *Proposed Plan for Landfill 1 (LF-1) Source Area and Groundwater and Chemical Spill 23 (CS-23) Groundwater:* Fact Sheet 2006-01. Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2006c (May). *Final Landfill-1 Source Area and Groundwater Feasibility Study*. Prepared by Jacobs Engineering for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 2002 (March). *Final Landfill-1 Interim Remedial Action Report.* Prepared by AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

_____. 1996 (September). *Final Remedial Investigation Main Base Landfill (AOC LF-1) and Hydrogeologic Region I Study.* Prepared by HAZWRAP for AFCEE/MMR, Installation Restoration Program, Otis ANG Base, MA.

ANG. 1995 (September). *AOC LF-1 Main Base Landfill Site Closure Report.* Prepared by ABB Environmental Services for ANG Readiness Center, Installation Restoration Program, Otis ANG Base, MA.

_____. 1995 (September). *Final Record of Decision Interim Remedial Action Containment of Seven Groundwater Plumes at MMR, Cape Cod MA* Prepared by Stone & Webster Environmental & Technology Services for ANG Readiness Center , Installation Restoration Program, Otis ANG Base, MA.

E.C. Jordan Co. 1990 (February). *Task 2-3B Site Inspection, Field Investigation Work Conducted Spring-Summer 1988.* Prepared for ANG Readiness Center, Installation Restoration Program, Otis ANG Base.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

4.4.15 Storm Drain No. 5 (SD-5) Groundwater

A. Background

A.1. Site Description. The SD-5 site is located at the southeast corner of the MMR. The SD-5 plume (Figure 4-13) was separated into the SD-5 North (SD-5N) and SD-5 South (SD-5S) plumes in 1997 when the SD-5N ETR system began operation. The COC for the SD-5 North and South plumes is TCE; EDB was also a COC in the SD-5 South plume. The residual groundwater contamination in the SD-5 area is no longer considered a plume (AFCEE 2006).

SD-5 groundwater contamination included a number of potential sources: tank flushing from the former Eastern and Western Aquafarms, the former NDIL (Building 3146), the former Corrosion Control Shop (Building 3117), the Permanent Field Training Site (Buildings 3140 and 3144), the sumps in Hangars 3122 and 3192, and a fuel spill that occurred in the early 1960s (FS-5).

AFCEE also excavated contaminated soil from the SD-5/FS-5 source area. In addition, AFCEE performed AS/SVE to remove chlorinated VOCs in the unsaturated zone. Refer to Section 3.2.38 for the status of SD-5/FS-5 source area.

A.2. Initial Responses (Non CERCLA Action).

Tank Removal Program: Between October 1994 and March 1995, during the MMR tank removal program, a total of 17 USTs, associated piping, and approximately 450 cubic yards of contaminated soil were removed from the Western and Eastern Aquafarms. See Section 3.2.38 for a description of SD-5 Source Area work.

A.3. Basis for Taking Action

The SD-5 site followed the CERCLA SI process. Described below is a summary of activities for SD-5.

1983 Record Search: The SD-5 AOC was first identified as a potentially hazardous site during the Phase I Records Search for the MMR, which was completed in 1983 (ANG 1983).

1990-1994 Drainage Structure Removal Program: Several source removal activities occurred in the SD-5 AOC between 1990 and 1996. In November of 1990, the ANG removed approximately 700 gallons of fluid from the NDIL leaching well, and four drainage structures at SD-5/FS-5 were removed in July 1996 as part of the MMR DSRP. The NDIL building and the Corrosion Control Shop were demolished and removed in April 1994.

1994 & 1996 Remedial Investigation: The basis for taking action was concentrations of chlorinated VOCs detected above MCLs and risk assessment results of the SERGOU RI conducted in 1994 (ANG 1994) and the revised risk assessment update for the SERGOU RI (AFCEE 1996). The baseline cancer risk calculations indicated that unless remedial action is undertaken, future residential exposure to contaminated groundwater may present an excess lifetime cancer risk greater than the acceptable MassDEP threshold of $1x10^{-5}$ and the acceptable EPA range of $1x10^{-4}$ to $1x10^{-6}$.

B. Remedial Actions

This section presents the regulatory actions, RAOs, remedy description, and remedy implementation for SD-5.

B.1. Regulatory Actions

1994 Plume Response Plan: A Plume Response Plan (OpTech 1994) was developed to contain seven groundwater plumes simultaneously. The Plume Management Process Action Team helped coordinate development of this plan. The Plume Response Plan was

used as a substitute for the Feasibility Study and as a basis to develop the Proposed Plan. The NGB, DoD, EPA, MassDEP, and local communities approved the plan, resulting in an accelerated effort toward "simultaneous containment" of the following seven groundwater plumes: AV, CS-10, Eastern Briarwood, FS-12, LF-1, SD-5, and Western Aquafarm.

<u>1995 Interim Record of Decision</u>: The NGB and EPA, with MassDEP concurrence, signed a Record of Decision for Interim Action (known as the IROD) (ANG 1995) for the seven groundwater plumes identified at the MMR. The preliminary design for the interim response action for the SD-5 plume included 15 extraction wells, treatment of the contaminated water with GAC, and 30 injection wells. After review of the conceptual interim response action, it was determined that this remedy could not be implemented without a detrimental impact to sensitive ecosystems.

<u>1997 Storm Drain-5 South Plume Response Decision Fact Sheet</u>: AFCEE, EPA and MassDEP introduced the DCM process, an accelerated decision-making tool to refine cleanup decisions. The DCM process was applied to the SD-5 South groundwater plume. The DCM gave the public an opportunity to review alternatives and make suggestions for final cleanup measures prior to the remedy selection. In December 1997, the *Storm Drain 5 South Plume Response Decision Fact Sheet* (AFCEE 1997) was issued to document the decision to implement the remedy.

Based on the investigational history and nature of the SD-5 South plume, a phased design and construction approach was adopted. Phase I addressed the axial portion of the plume and included two circulating wells. Phase II addressed the southernmost portion of the plume and included one extraction well for the SD-5 South plume with treatment at the SRTF.

<u>1997-2004 SD-5 Interim Remedial Treatment Systems</u>: The SD-5 groundwater contaminants have largely been removed by the three interim remedial systems including: SD-5 North ETR system; SD-5S recirculation well system; and the SD-5S/TCE plume

(currently known as the CS-10 Northern lobe) extraction well system. Descriptions for these systems are provided below.

- SD-5 North ETR System: The SD-5 North ETR system began operation in August 1997. The SD-5 North ETR system consisted of 10 closely-spaced extraction wells, GAC, and eight reinjection wells. The extracted groundwater was processed through the SRTF. At the SRTF, the extracted groundwater was treated using GAC filters to remove organic contaminants. After treatment, the water was returned to the ground through a series of eight reinjection wells situated downgradient of the extraction wells along the MMR boundary. The SD-5 North ETR system operated in various configurations until August 2003.
- SD-5 South Axial System (Phase I): The SD-5S Axial Recirculating Well Remedial system began operation in June 1999. The SD-5S Axial Recirculating Well Remedial System consisted of two recirculating wells located axially in the southern portion of the SD-5S plume on Highland and Wheeler roads between Ashumet Pond and Johns Pond. Water treatment consisted of air stripping influent water within the wellhead vault, followed by filtration of the air stream by primary and secondary activated carbon units. Treatment systems were housed in below-grade vaults installed at each recirculating well location. The SD-5 Phase I South Axial System operated in various configurations until April 2003.
- SD-5S Hoophole Road Extraction Well System (Phase II): The SD-5S Hoophole Road remedial system consisted of one extraction well in the SD-5 South plume. It should be noted that this system was constructed in conjunction with an extraction well for the TCE plume (CS-10 Northern lobe) which was also located along Hoophole Road and is still in operation. Extracted groundwater was pumped to the SRTF for treatment and the treated water was reinjected into the aquifer through a combination of the SD-5 North reinjection wells and the CS-10 Sandwich Road reinjection wells. This Phase II began operation in January 2000. On 25 February 2004, the SD-5 South Hoophole Road extraction well was turned off.

<u>Engineering Controls</u>: Workers and residents at MMR are connected to a public water supply. Residents of Mashpee and Briarwood neighborhood also have been connected to public water supply.

B.2. Remedial Action Objectives. RAOs: The RAOs identified in the ROD (AFCEE 2006) are:

- Prevent or reduce exposure to on-base and off-base SD-5 groundwater with TCE concentrations greater than the MCL of 5 μg/L.

- Return useable groundwater to beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site.

B.3. Final Remedy

2004 Feasibility Study: A feasibility study has been completed for the SD-5 Groundwater Operable Unit. Major components of the feasibility study included preparation of human health and ERAs for groundwater and Johns Pond, identification of RAOs, and development of remedial alternatives.

- Risk Assessments: The groundwater risk assessment used the following screening criteria: EPA Region IX preliminary remedial goals for residential tap water, EPA MCLs, and MassDEP GW-1 groundwater standards. Cancer risks and non-cancer hazards were evaluated for residential exposures to on-base groundwater, off-base groundwater, and Johns Pond. TCE was selected as a human health COC for on-base and off-base groundwater. The results of the ERA conducted for Johns Pond indicated that there is no ecological concern to aquatic and benthic organisms.
- Remedial Alternatives: Three remedial alternatives were identified and received detailed and comparative analyses. They included: (1) No Action, (2) Land Use Controls and Long Term Monitoring, and (3) Construction, Operation, Maintenance, and Monitoring of a new SD-5 ETR System.

2006 Record of Decision: The selected remedy for the SD-5 Groundwater Operable Unit (i.e., LUCs and LTM) is documented in the Final ROD for Groundwater at Eastern Briarwood, Western Aquafarm, and Storm-Drain 5 (AFCEE 2006). Components of the selected remedy are described below:

Long Term Monitoring Program: AFCEE has developed a monitoring plan for the SD-5 Groundwater Operable Unit that will include data from a network of monitoring wells. The monitoring wells will be sampled periodically for VOCs. Periodic monitoring results will be reported in a letter report. Monitoring will continue for two years beyond the time TCE concentrations decrease below the MCL.

Residual Risk Assessment: A residual risk assessment and/or evaluation of the technical and economic feasibility of additional remediation to approach or achieve background concentrations would be conducted if deemed necessary.

Five Year Review: CERCLA Five-year reviews will be performed to evaluate remedy appropriateness and site status for as long as hazardous substances remain above unrestricted use levels in the groundwater.

Land-Use Controls: SD-5 contaminated groundwater has migrated past the MMR boundary into the neighboring town of Mashpee. Administrative and/or legal controls (i.e., LUCs) are required to avoid risk to exposure to groundwater from the SD-5 area. The Air Force is responsible for ensuring that the following LUCs are established, monitored, maintained, and reported. A detailed description of the LUC program is included in Section 4.3.

C. Progress Since the Last Five-Year Review

The following activities were conducted/ observed since the last review:

- SD-5 South Axial system (Phase I) was shutdown in 2003.
- SD-5 North ETR System was shutdown in 2003.
- SD-5 South Hoophole Road extraction well System (Phase II) was shutdown in 2004.
- A Final Feasibility Study was completed in 2004 (AFCEE 2004).
- A Final ROD was completed in September 2006 (AFCEE 2006) to document LTM and institutional controls as the final remedy for the SD-5 plume.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

No, the LUCs intended to prevent exposure to contaminated groundwater are not adequate to ensure long term protectiveness. Although there is no known exposure, additional measures to ensure long term protectiveness are warranted as described in Section 4.3

The LTM is functioning as intended by the ROD and is expected to achieve cleanup levels. Monitoring costs are appropriate for the remedy. Monitoring and evaluation activities are continual and well-documented. Because of the decreasing trend in concentrations of TCE, the LTM program for the SD-5 Groundwater Operable Unit has been optimized to include a fewer number of monitoring wells to be sampled as well at a reduced frequency (annually to biennially).

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered, Toxicity, and Risk Assessment Methodology</u>: The Federal MCL is the cleanup standard for TCE. The Federal MCL has not changed since the last five-year review.

<u>Changes in Exposure Pathways</u>: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the remedy.

<u>Review of RAOs</u>: The RAOs currently require the Air Force to “prevent or reduce exposure.” This RAO should be modified to eliminate the word “reduce” to better ensure long term protectiveness.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up

See Section 4.3 for a full discussion of the LUC issue and recommendations. RAOs should be modified as described in Question B.

F. Protectiveness Statement

The remedy is protective in the short-term; however, in order for the remedy to be protective in the long term, follow-up actions regarding VI as described in Section 4.1 and LUCs as described in Section 4.3 need to be taken.

G. References

AFCEE. 2006 (October). *Final Record of Decision for Groundwater at Eastern Briarwood, Western Aquafarm, and Storm Drain-5.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 2004 (September). *Final Storm Drain-5 Groundwater Feasibility Study.* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1997 (December). *Storm Drain 5 South Plume Response Decision Fact Sheet*. Prepared by AFCEE, Installation Restoration Program, Otis ANG Base, MA.

_____. 1996. *Revised Risk Assessment Update Southeast Region Groundwater Operable Unit (Including Region III) Remedial Investigation Report.* Prepared by ABB Environmental Services, Inc. for AFCEE and ANG MMR Installation Restoration Program, Otis ANG Base, MA.

ANG. 1995 (September). *Final Record of Decision Interim Remedial Action Containment of Seven Groundwater Plumes at MMR, Cape Cod MA* Prepared by Stone & Webster Environmental & Technology Services for ANG Readiness Center , Installation Restoration Program, Otis ANG Base, MA.

_____. 1994 (August). *Draft Southeast Region Groundwater Operable Unit Remedial Investigation Report (Including Region III)*. Prepared by ABB Environmental Services, Inc. for ANG MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1983. *Installation Restoration Program, Phase I Records Search*. Otis ANG Base. Prepared by Metcalf and Eddy, Inc. for ANG MMR Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

OpTech. 1994 (June). *Plume Response Plan*. Prepared for the Plume Management Process Action Team.

4.4.16 Western Aquafarm Groundwater

A. Background

A.1. Site Description. The Western Aquafarm site was identified as a potential source of contamination during a 1986 expanded records search (ANG 1986). The Western Aquafarm consisted of six 25,000-gallon USTs that were used in the 1950s and 1960s to store and transfer AVGAS and JP-4. Fuel was transferred from the tanks by pumping water in the tanks to displace the fuel. To refill the tanks with fuel, the water was displaced and was discharged into a 1-acre basin within the Central Drainage Swale.

The initial profile of the Western Aquafarm plume was based on the SERGOU RI which was completed in 1994 (ANG 1994). The SERGOU also included the Eastern Briarwood plume and the SD-5 plume. Groundwater COCs in the Western Aquafarm plume consisted of fuel-related compounds. At the time of the Plume Response Plan (OpTech 1994), the Western Aquafarm plume was approximately 1,550 feet long, approximately 825 feet wide, and 40 to 60 feet thick.

A.2. Initial Responses (Non CERCLA Action). As part of the MMR tank removal program, all USTs and associated piping at the Western Aquafarm were removed in October 1994 (ANG 1995a). No evidence of leakage was observed in any of the tanks. Evidence of leakage associated with the piping and transfer support system was noted in conjunction with one tank. Approximately 450 cubic yards of contaminated soil were excavated and removed for thermal treatment.

A.3. Basis for Taking Action. The Western Aquafarm Groundwater Operable Unit followed the CERCLA SI process. Described below is a summary of activities for the Western Aquafarm Groundwater Operable Unit.

<u>1994 SERGOU RI</u>: The basis for taking action for groundwater were the site characterization and risk assessment results of the SERGOU RI completed in 1994

(ANG 1994). A benzene plume was delineated from the Western Aquafarm to the base boundary.

1995 IROD**:** An IROD was completed in 1995 (ANG 1995b) which presented a plume containment interim remedy for the Western Aquafarm Groundwater Operable Unit. An interim response action to contain the Western Aquafarm plume at the leading edge was developed that conceptually consisted of nine extraction wells, treatment of the contaminated water with GAC, and 18 reinjection wells on the MMR boundary. It was determined that implementation of this remedy could have an adverse impact on the surrounding ecosystem and also cause undesirable alterations to regional groundwater flow.

1996 Data Gap Investigation: In 1996, a data gap investigation was performed. Results of the data gap investigation indicated that contaminant concentrations were low. Based on the data gap investigation and potential negative effects of the conceptual remedial action, the approach for the Western Aquafarm Groundwater Operable Unit was revised in the Strategic Plan (AFCEE 1997) from the active leading edge remedial system previously presented in the IROD to LTM.

1996 – 2005 LTM Program: In 1996, a LTM program was initiated for the Western Aquafarm Groundwater Operable Unit to assess contaminant trends and distributions. The primary contaminants detected in the Western Aquafarm Groundwater Operable Unit were fuel-related compounds. Between 1996 and 2005, monitoring wells were installed and over 270 groundwater samples were collected.

2005 Groundwater Risk Assessment: In support of reaching a final ROD for the Western Aquafarm Groundwater Operable Unit, a risk assessment was performed (AFCEE 2005) using data collected from the LTM program and supplemented by additional data specifically to support the risk assessment. The groundwater risk assessment used the following screening criteria: EPA Region IX preliminary remedial goals for residential

tap water (EPA 1999), EPA MCLs, and MassDEP MCP GW-1 groundwater standards. Future adult and child resident exposure scenarios were evaluated. All concentrations of xylenes were below the Federal MCL, but the calculated hazard quotient for xylene indicated the potential for unacceptable health risks. However, AFCEE, EPA, and MassDEP evaluated the exposure assumptions as well as spatial and temporal distribution of xylenes in the Western Aquafarm Groundwater Operable Unit, and determined that the only place where xylene concentrations are at potentially unacceptable levels is near a single monitoring well on a secure portion of the base, and furthermore that it is naturally attenuating in its current position. Because there is no potential current or future residential exposure to remaining xylene residue, AFCEE, EPA, and MassDEP agreed that no further action was warranted to be protective of human health and the environment.

B. Remedial Actions

This section presents the regulatory actions for the Western Aquafarm Groundwater Operable Unit. Remedy description and RAOs are not applicable for the Western Aquafarm Groundwater Operable Unit.

B.1. Regulatory Actions.

Record of Decision**:** The remedy for the Western Aquafarm Groundwater Operable Unit is no further action. The no further action decision was documented in the Final ROD for Groundwater at Eastern Briarwood, Western Aquafarm, and Storm-Drain 5 (AFCEE 2006). The no further action decision is based on the results of the groundwater risk assessment based on residential exposure scenarios (AFCEE 2005).

C. Progress Since the Last Five-Year Review

The following activities were conducted/ observed since the last review.

- LTM of groundwater which began in 1996 was completed in 2005.

- A groundwater risk assessment was completed for the Western Aquafarm Groundwater Operable Unit using future residential exposure scenarios in 2005 (AFCEE 2005).
- A Final ROD was completed in September 2006 (AFCEE 2006) to document no further action for the Western Aquafarm Groundwater Operable Unit.

D. Technical Assessment

The technical assessment component of the five-year review consists of evaluating the protectiveness of the remedy. AFCEE performed the technical assessment based on EPA guidance provided in Section 4.0 of the Comprehensive Five-Year Review Guidance (EPA 2001).

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the no further action decision is still applicable for the Western Aquafarm Groundwater Operable Unit.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

<u>Changes in Standards and To-Be Considered</u>: MassDEP has re-evaluated GW-1 groundwater standards since the ROD was completed in September 2006. The MassDEP GW-1 groundwater standards are based on residential use. The new MassDEP GW-1 groundwater standards became effective on February 14, 2008 [see 310 CMR 40.0974(2)]. The new MassDEP GW-1 groundwater standards do not require a re-evaluation of the no further action decision for the Western Aquafarm Groundwater Operable Unit. The MassDEP GW-1 groundwater standard for xylene (10,000 parts per billion) is identical to the MCL for xylene, and at the time of the ROD, xylene concentrations were already below this level.

The risk assessment completed in 2005 used 1999 EPA Region IX PRGs as screening values for the identification of COPCs. EPA Region IX revised PRGs in 2004. The new

PRGs do not require a re-evaluation of the risk assessment which served as the basis for no further action for the Western Aquafarm Groundwater Operable Unit.

Changes in Exposure Pathways: There have been no changes to exposure pathways and land use of the site that would affect the protectiveness of the no further action remedy.

Changes in Toxicity and Other Contaminant Characteristics: There have been no changes to toxicity and other contaminant characteristics that would affect the protectiveness of the no further action remedy.

Changes in Risk Assessment Methods: There have been no changes to risk assessment methods that would affect the protectiveness of the no further action remedy.

Review of RAOs: RAOs are appropriate.

Question C: Has any other information come into light that could call into question the protectiveness of the remedy?

No.

E. Issues/Recommendations and Follow-Up

None.

F. Recommendations and Follow-Up Actions

None.

G. Protectiveness Statement

The decision of no further action selected for the Western Aquafarm Groundwater Operable Unit is protective of human health under a residential exposure scenario and also of the environment. No restrictions are required for the site and the site no longer requires a five-year review.

H. References

AFCEE. 2006 (October). *Final Record of Decision for Groundwater at Eastern Briarwood, Western Aquafarm, and Storm Drain-5* Prepared by Jacobs Engineering Group Inc. for AFCEE/MMR Installation Restoration Program, Otis ANG Base, MA.

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ANG. 1995a (August). *Closure Report –Aqua Fuel Farm – Tank Removal and Site Restoration, Otis Air National Guard Base.* Prepared by Environic Solutions Inc. for ANG MMR Installation Restoration Program, Otis ANG Base, MA.

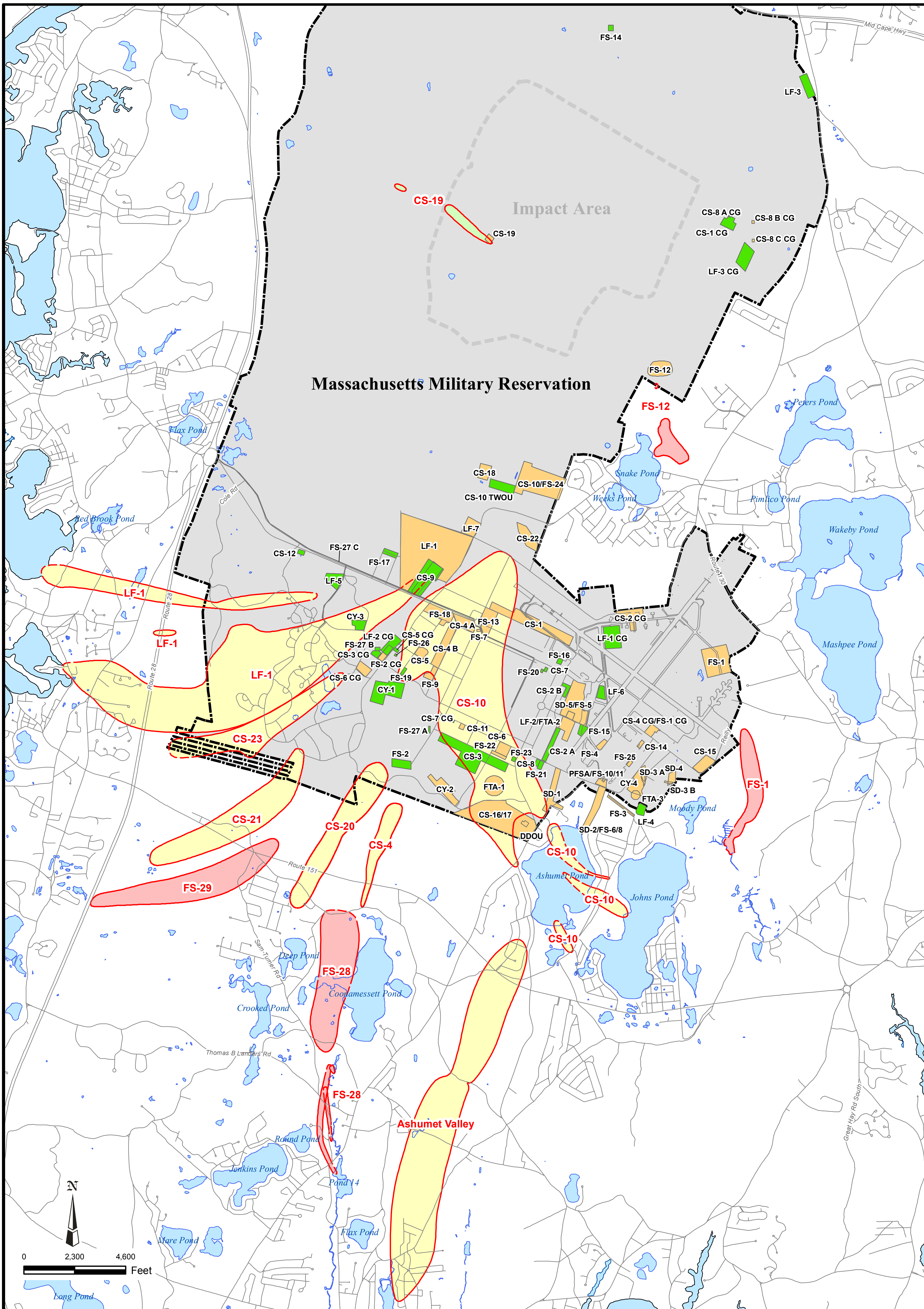
_____. 1995b (September). *Final Record of Decision for Interim Action Containment of Seven Groundwater Plumes at Massachusetts Military Reservation, Cape Cod, Massachusetts*. Prepared by Stone & Webster, Environmental Technology & Services for ANG MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1994 (August). *Draft Southeast Region Groundwater Operable Unit Remedial Investigation Report (Including Region III)*. Installation Restoration Program, Massachusetts Military Reservation. Prepared by ABB Environmental Services, Inc. for ANG MMR Installation Restoration Program, Otis ANG Base, MA.

_____. 1986 (December). U.S. Air Force Installation Restoration Program, Phase I: Records Search, Air National Guard, Camp Edwards (ARNG), U.S. Air Force and Veterans Administration Facilities at Massachusetts Military Reservation, Task 6. Prepared by E.C. Jordan Co. for ANG Installation Restoration Program, Otis ANG Base, MA.

EPA. 2001 (June). *Comprehensive Five-Year Review Guidance*, EPA 540R-01-007.

OpTech. 1994 (June). *Plume Response Plan.* Prepared for the Plume Management Process Action Team.



Data Source: AFCEE, MMR-AFCEE Data Warehouse

Legend

- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Impact Area
- Source Areas Undergoing 5-Year Review
- Source Areas - No Further Action Sites
- EDB Plume - Represent an exceedance of Ethylene Dibromide (1,2-dibromoethane), EDB MMCL = 0.02 µg/L
- TCE Plume - Represent an exceedance of Trichloroethene (TCE), TCE MCL = 5.0 µg/L
- Explosives Plume Concentrations Above EPA Health Advisory Levels, Royal Demolition Explosive (RDX) GW-1 standard = 1 ppb

FIGURE 1-1

ALL MMR - IRP SITES

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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What is Superfund?
Superfund is the nickname for the environmental cleanup program legally known as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a federal law, enacted in 1980. Superfund provides the authority through which the Federal government can compel people or companies responsible for creating hazardous waste sites to clean them up. It also created a public trust fund, known as the Superfund, to assist with the cleanup of inactive and abandoned hazardous waste sites or accidentally spilled or illegally dumped hazardous materials.

See also EPA's Superfund Internet Resources
Superfund Process:
http://www.epa.gov/superfund/action/process/sfprocess.htm
General Superfund:
http://www.epa.gov/superfund/index.htm

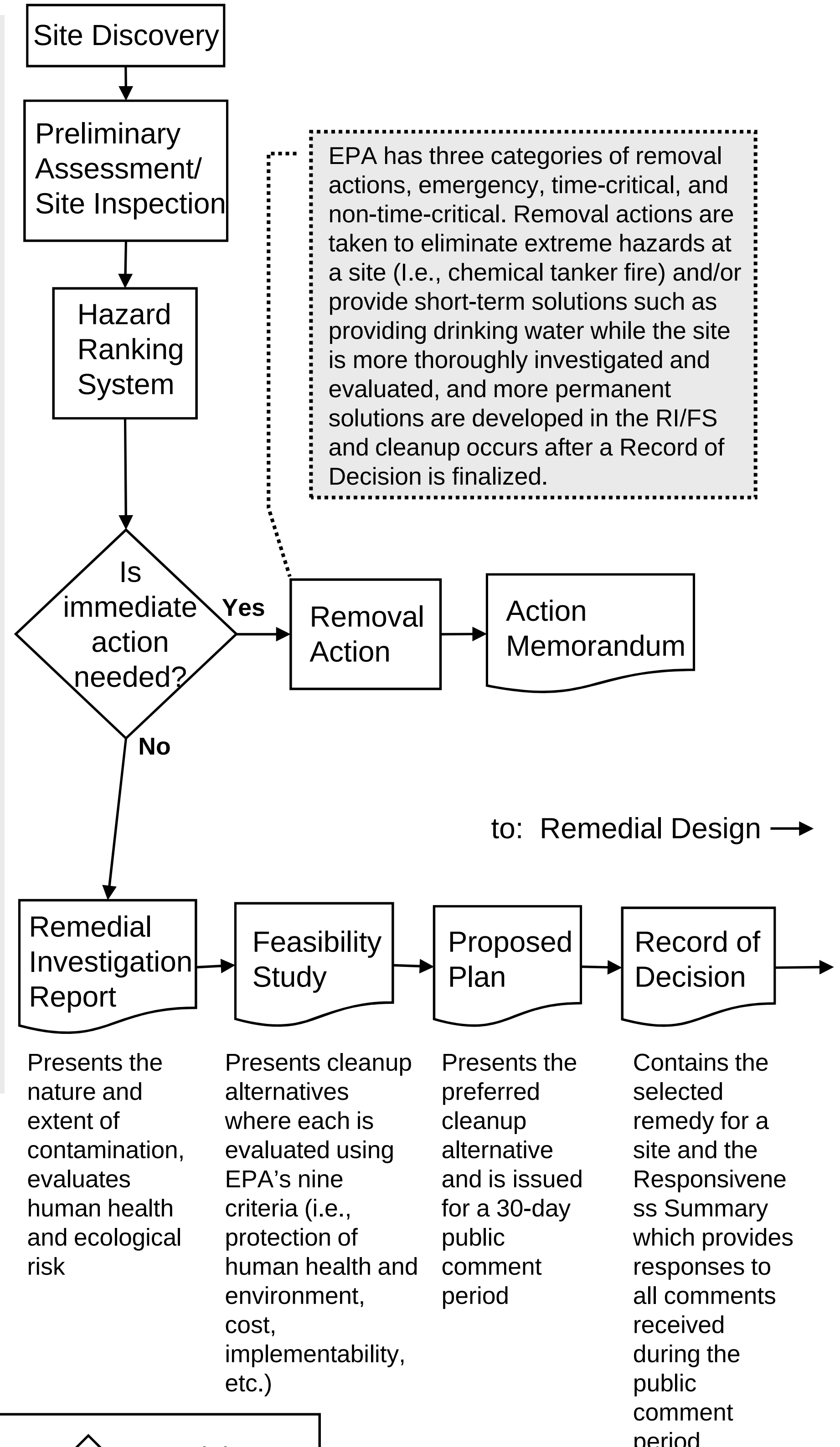
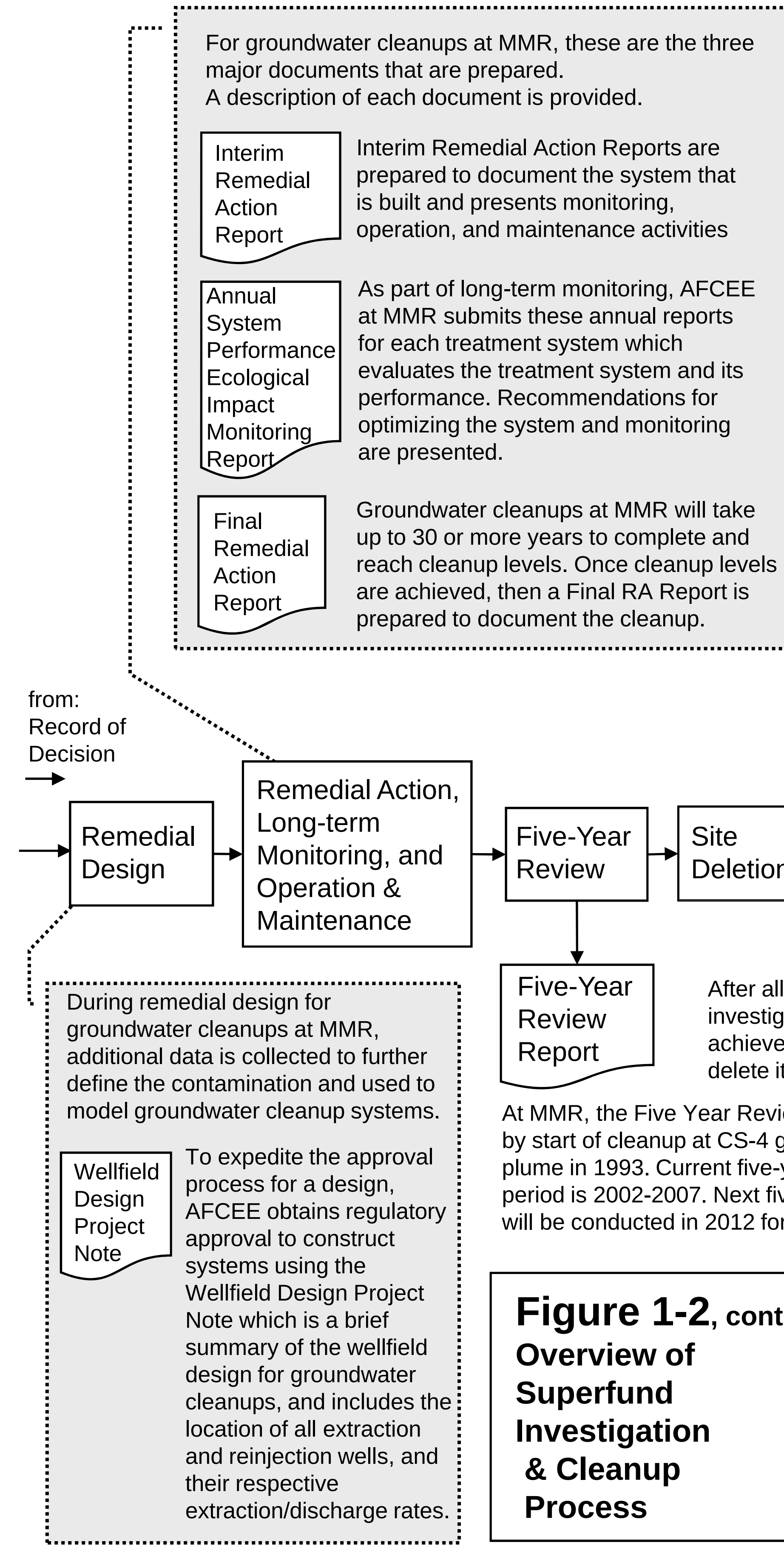


Figure 1-2: Overview of Superfund Investigation & Cleanup Process

LEGEND: Decision Point; Document; Process



This flowchart begins in the upper left with "Site Discovery" and is an overview of the Superfund process. A site is added to the National Priorities List and is called a Superfund Site if it has a score of 28.5 or greater using the a scoring system which is called the Hazard Ranking System. Since the investigation and cleanup process takes several years, sites are evaluated early in the process to determine if any short-term actions or removal actions need to be taken. Details are provided in comments associated with certain steps in the flowchart. Typical Superfund sites have only one to three operable units and are smaller in comparison to federal facility sites such as the Massachusetts Military Reservation (MMR) which has 80 sites in its Installation Restoration Program (IRP).

Figure 1-2, continued: Overview of Superfund Investigation & Cleanup Process

LEGEND: Decision Point; Document; Process

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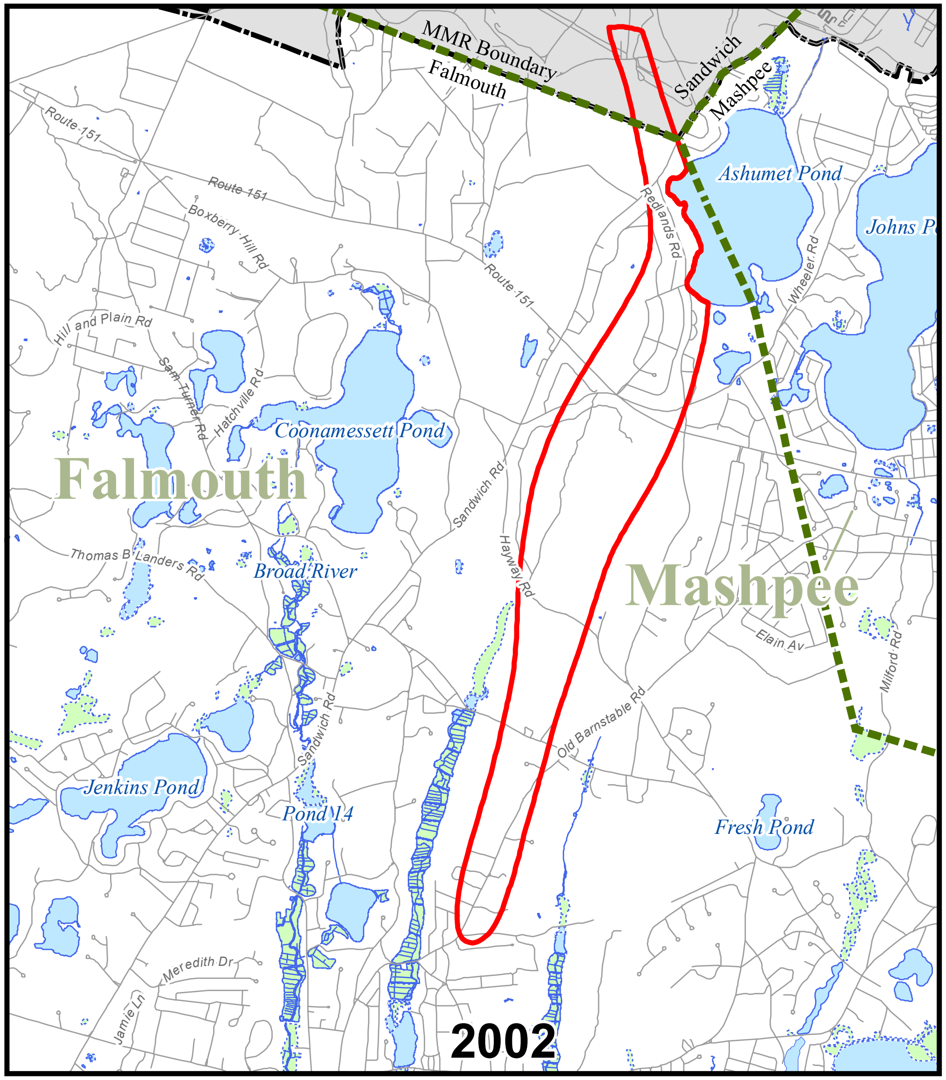

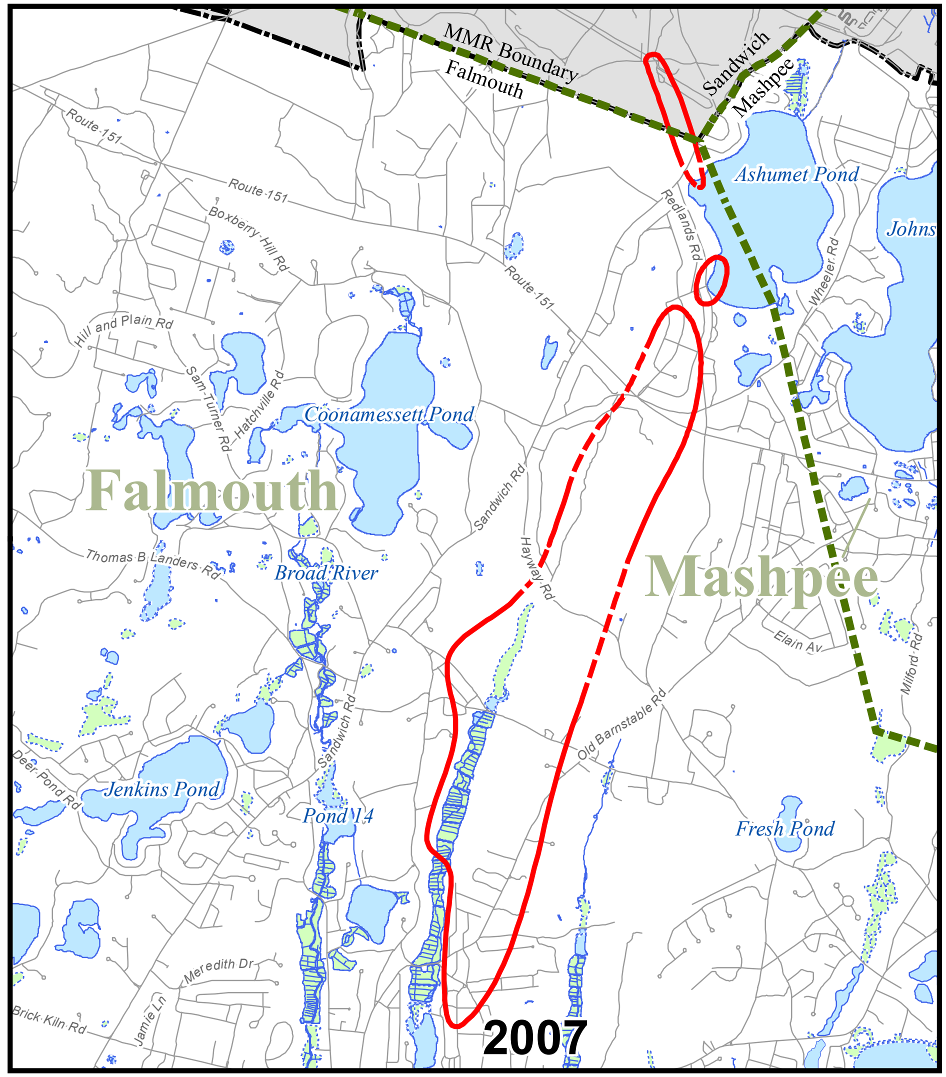

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 2,250 4,500 Feet

FIGURE 4-1

ASHUMET VALLEY PLUMES 2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

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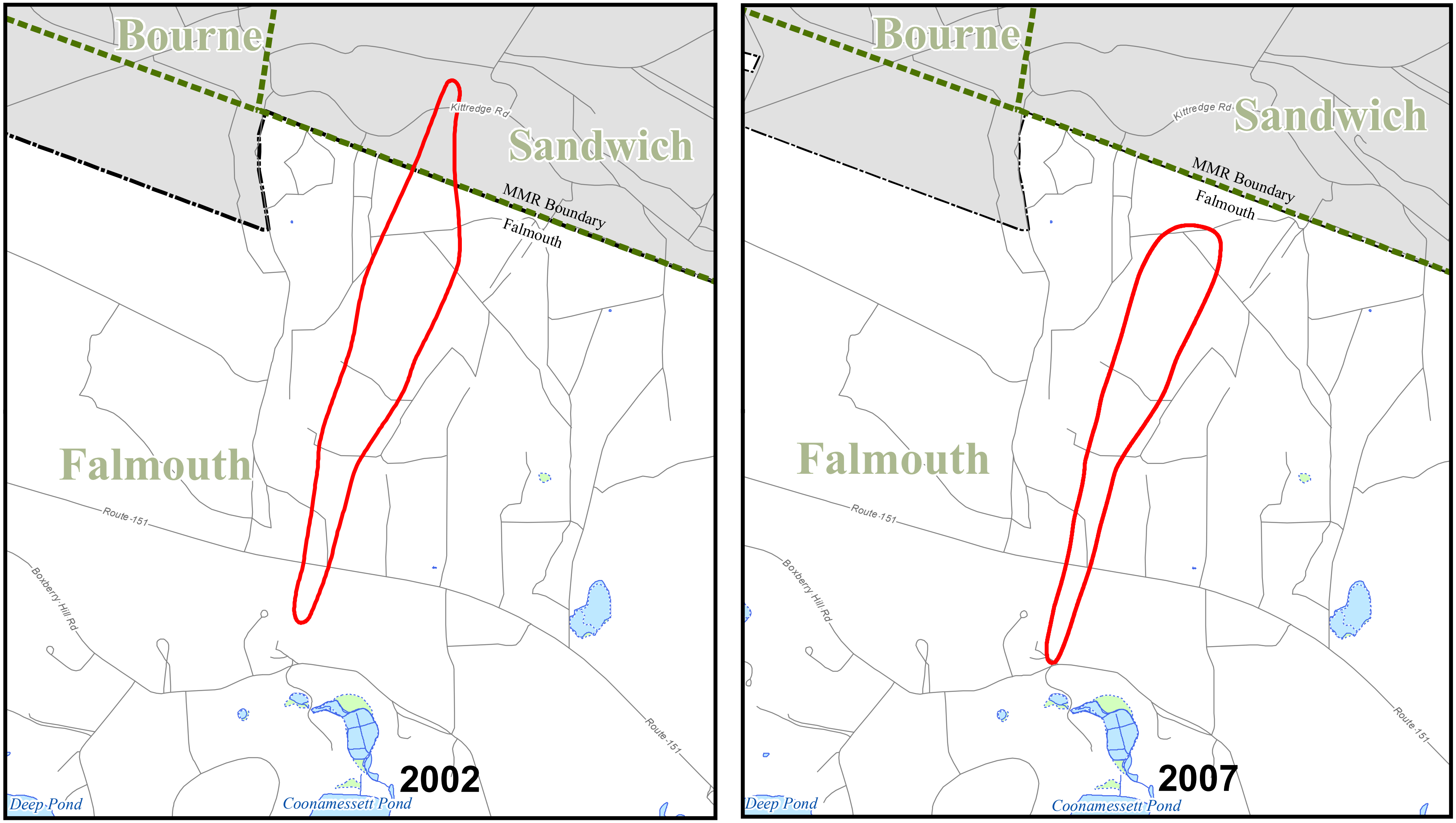

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 790 1,580 Feet

FIGURE 4-2

CS-4 PLUMES 2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

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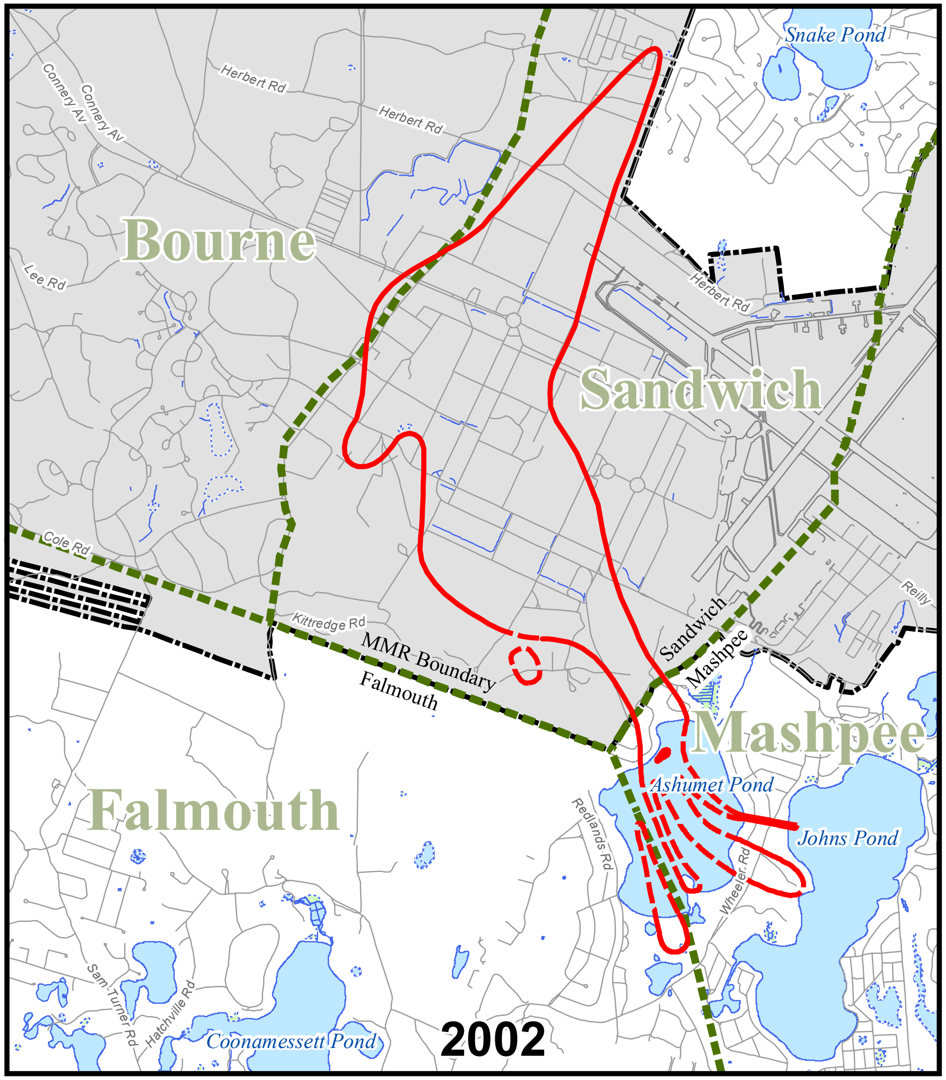

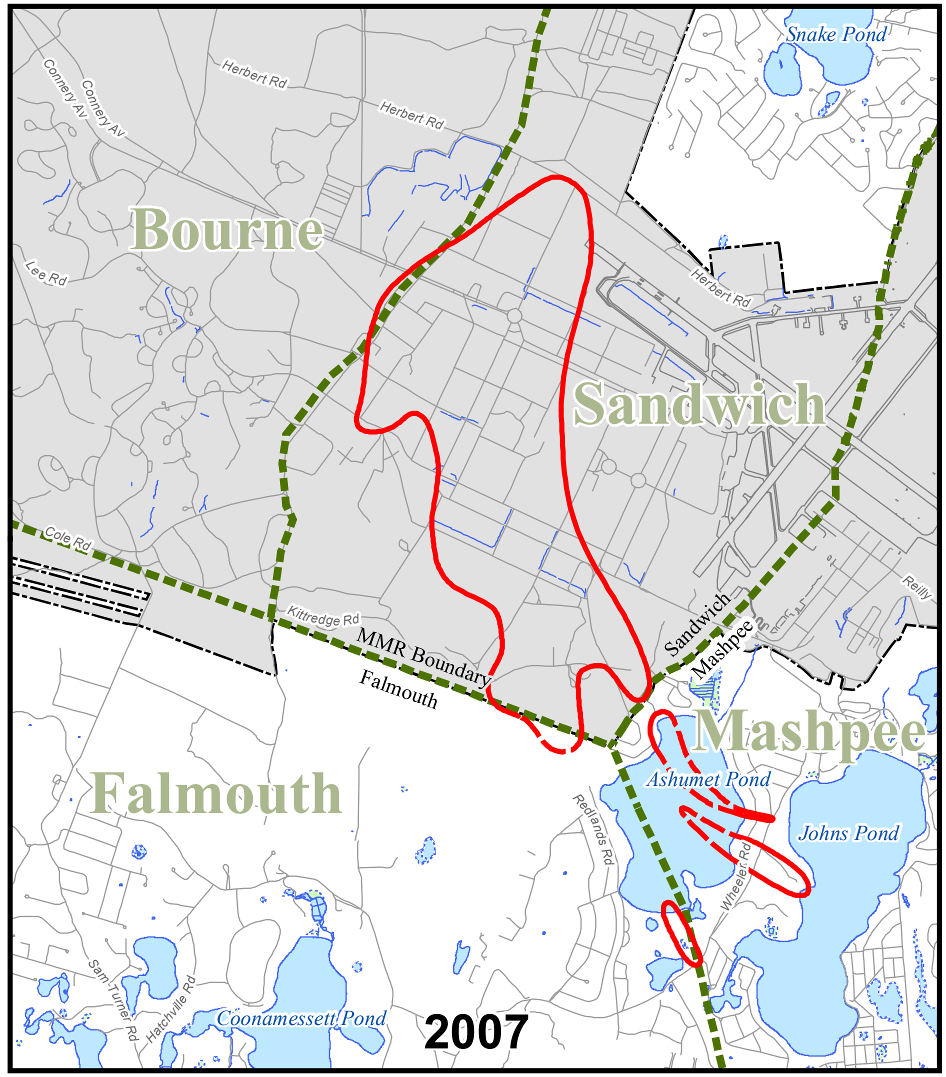

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 2,250 4,500 Feet

FIGURE 4-3

CS-10 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

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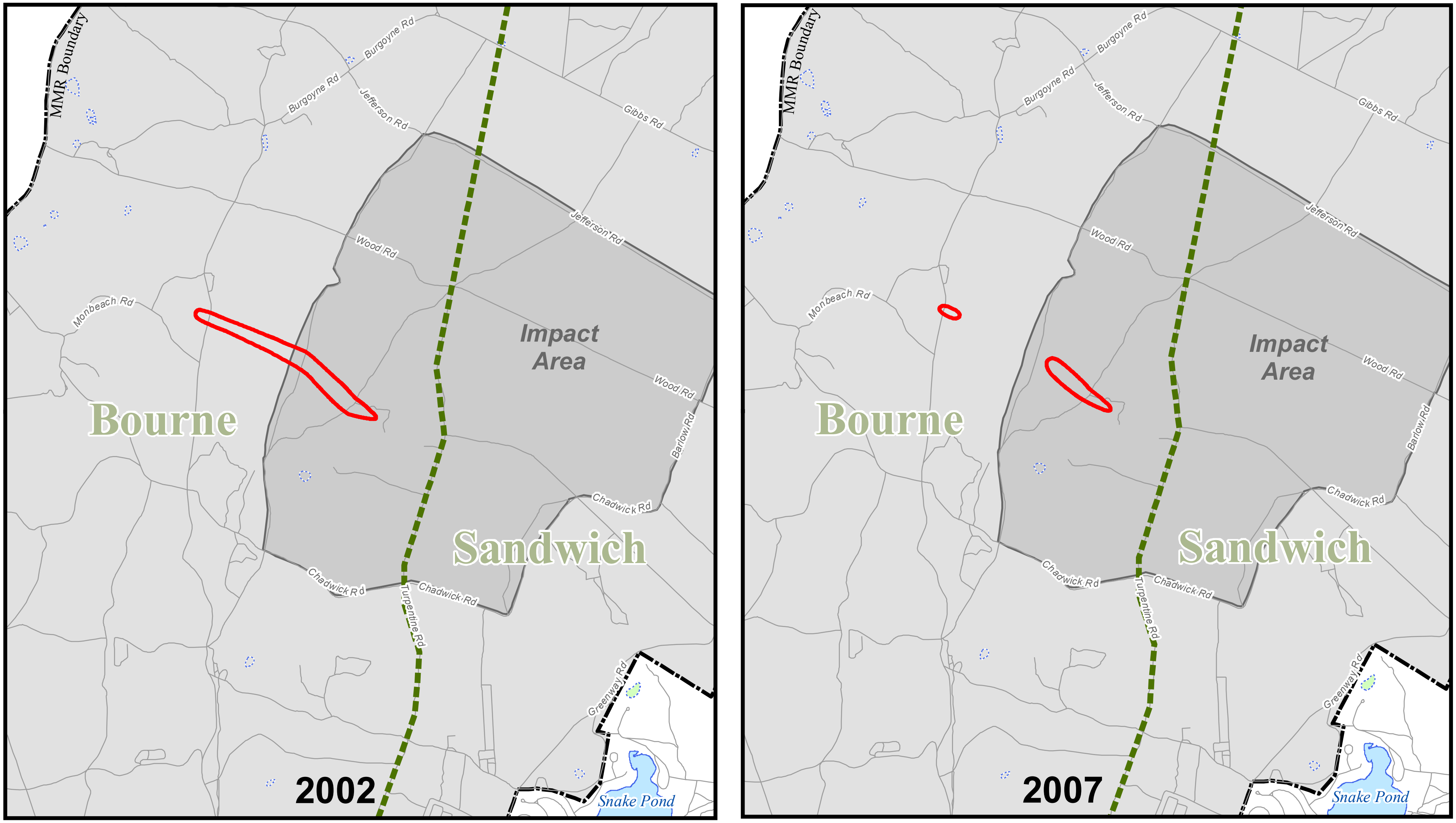

Legend

Town Boundary

Massachusetts Military Reservation Boundary

Plume Boundary

Bog/Wetland

Impact Area

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,900 3,800 Feet

FIGURE 4-4

CS-19 PLUMES 2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

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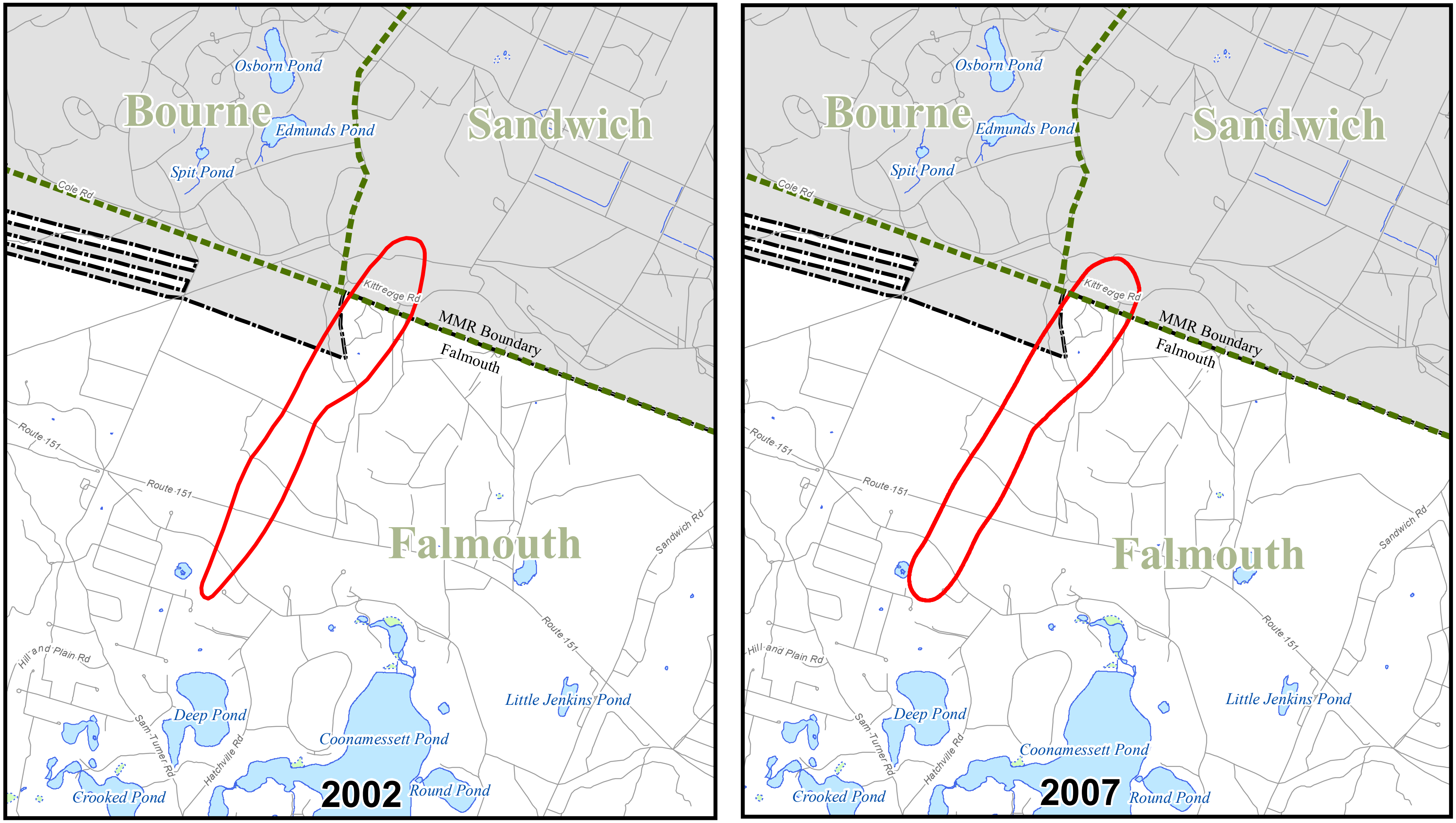

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,400 2,800 Feet

FIGURE 4-5

CS-20 PLUMES 2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

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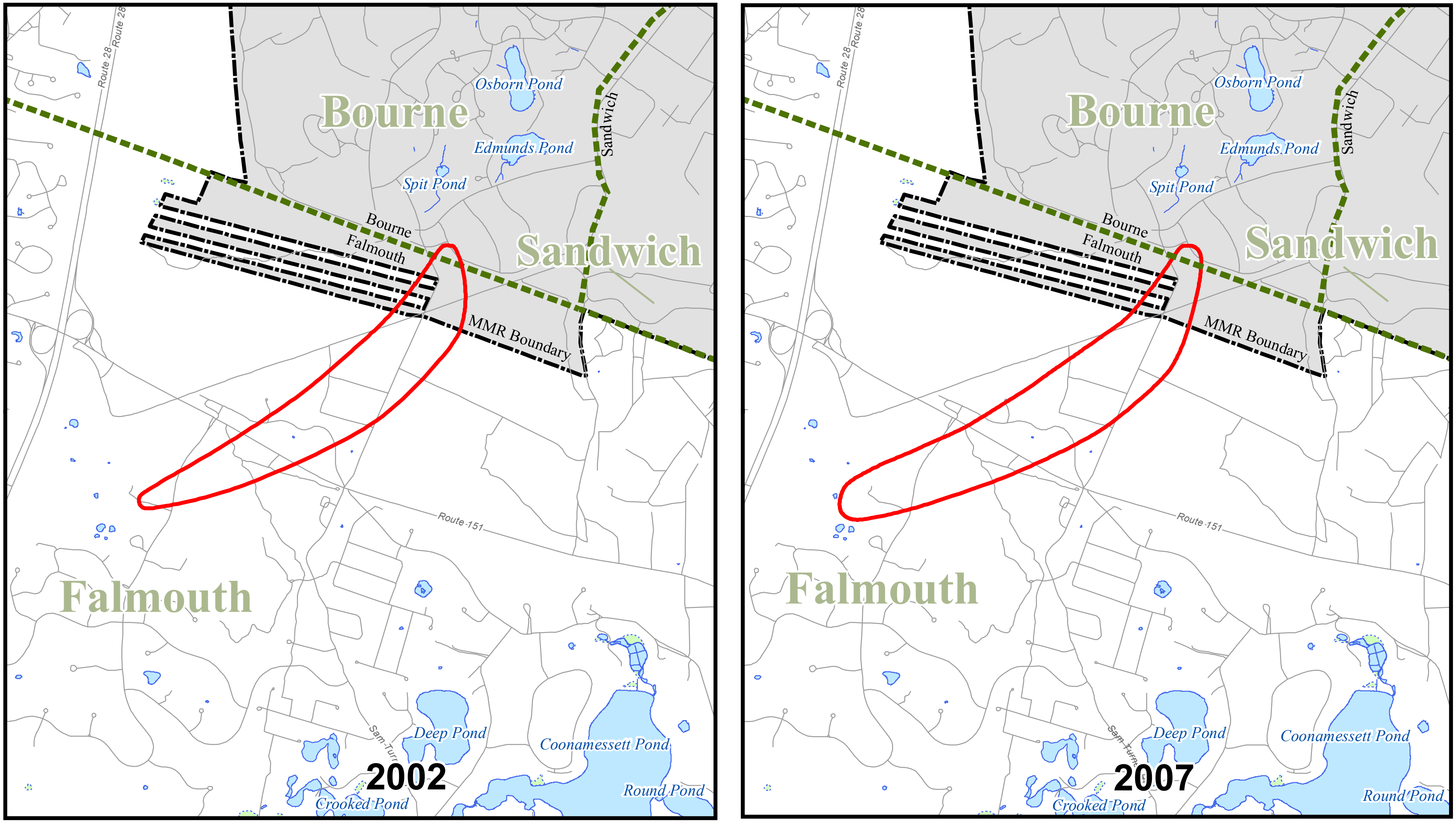

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,400 2,800 Feet

FIGURE 4-6

CS-21 PLUMES
2002 AND 2007 COMPARISON
AFCEE - Massachusetts Military Reservation
5 Year Review

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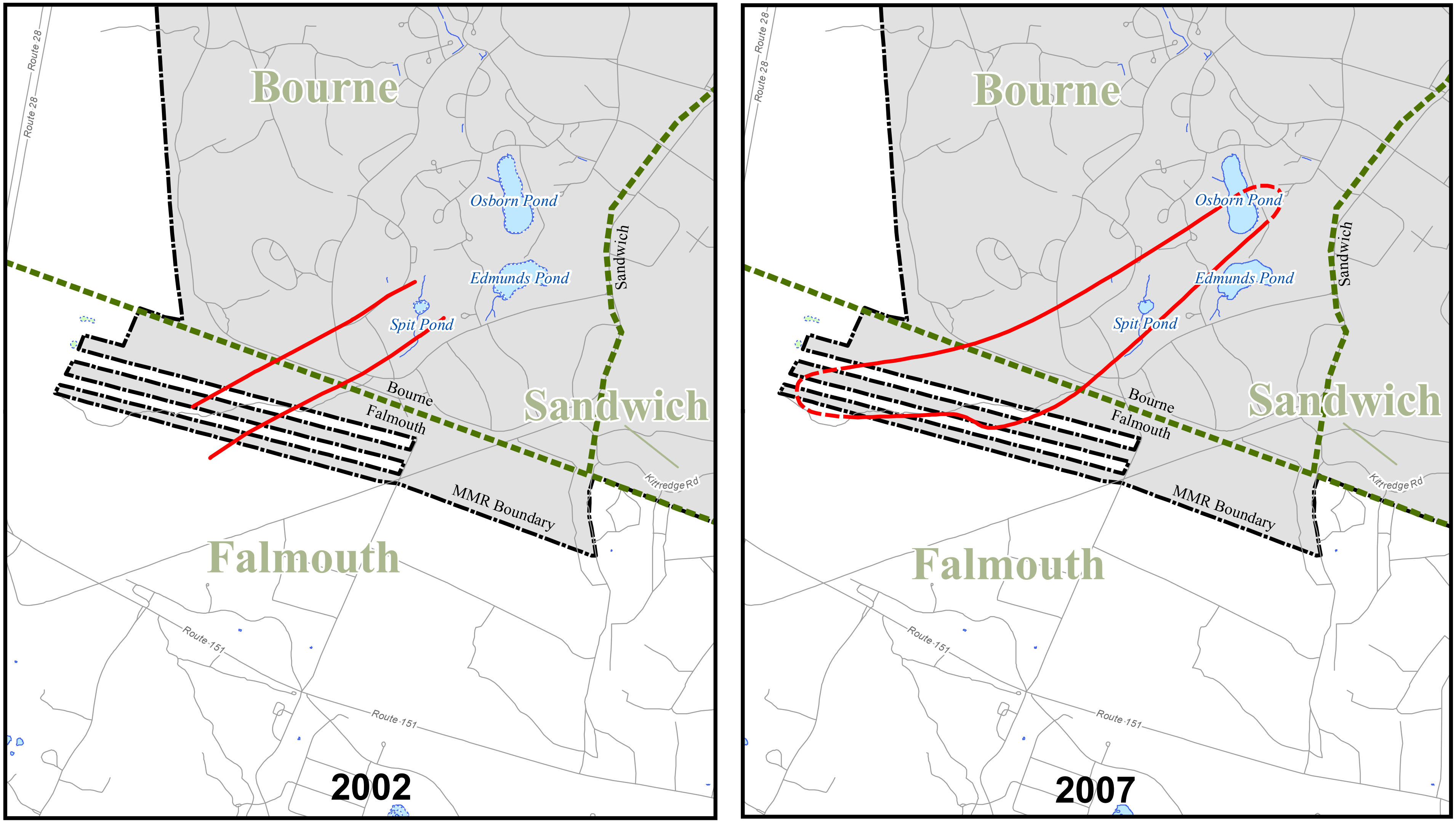

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,300 2,600 Feet

FIGURE 4-7

CS-23 PLUMES
2002 AND 2007 COMPARISON
AFCEE - Massachusetts Military Reservation
5 Year Review

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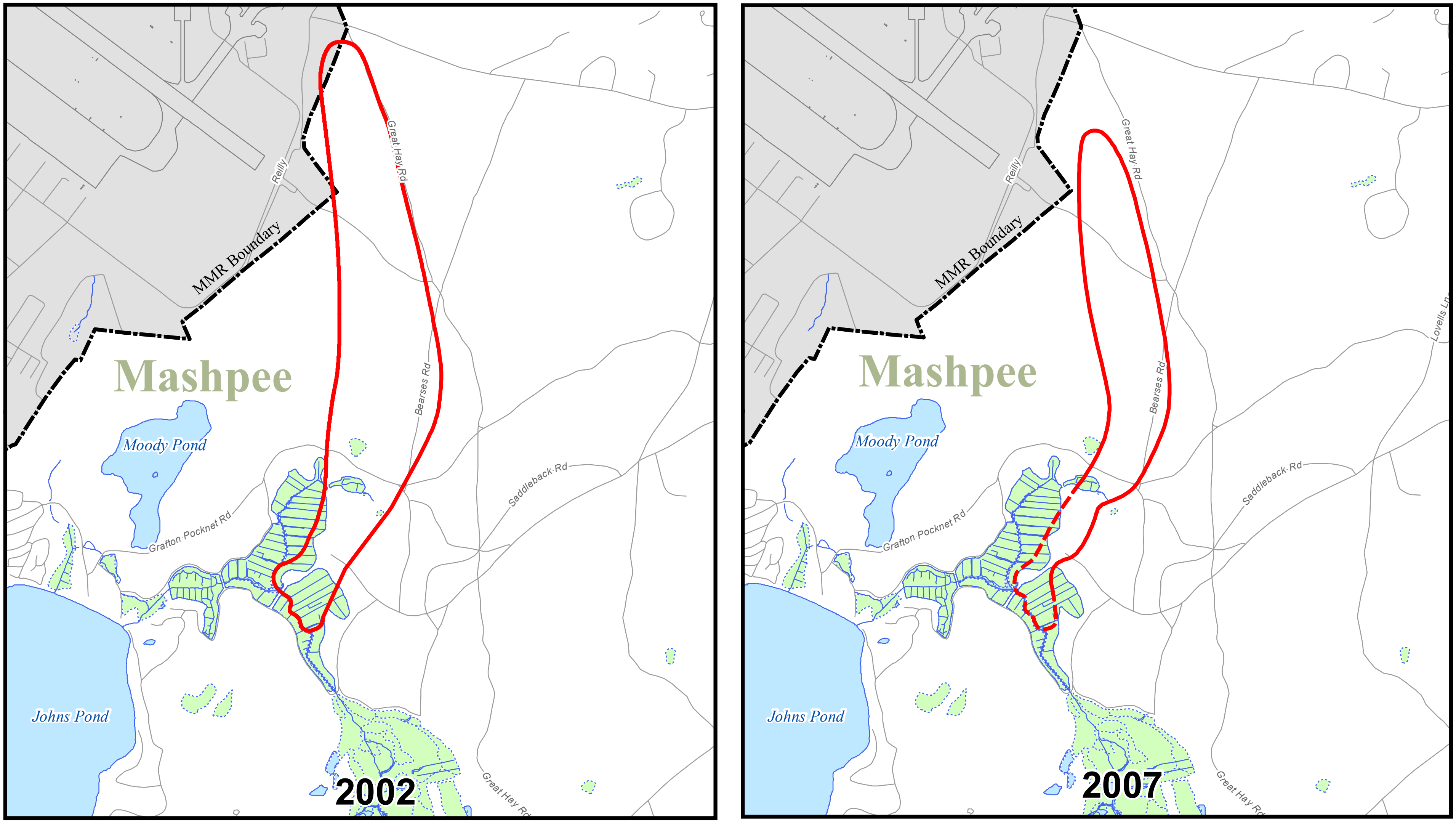

Legend

Town Boundary

Massachusetts Military Reservation Boundary

Plume Boundary (Dashed Where Inferred)

Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 840 1,680 Feet

FIGURE 4-8

FS-1 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation
5 Year Review

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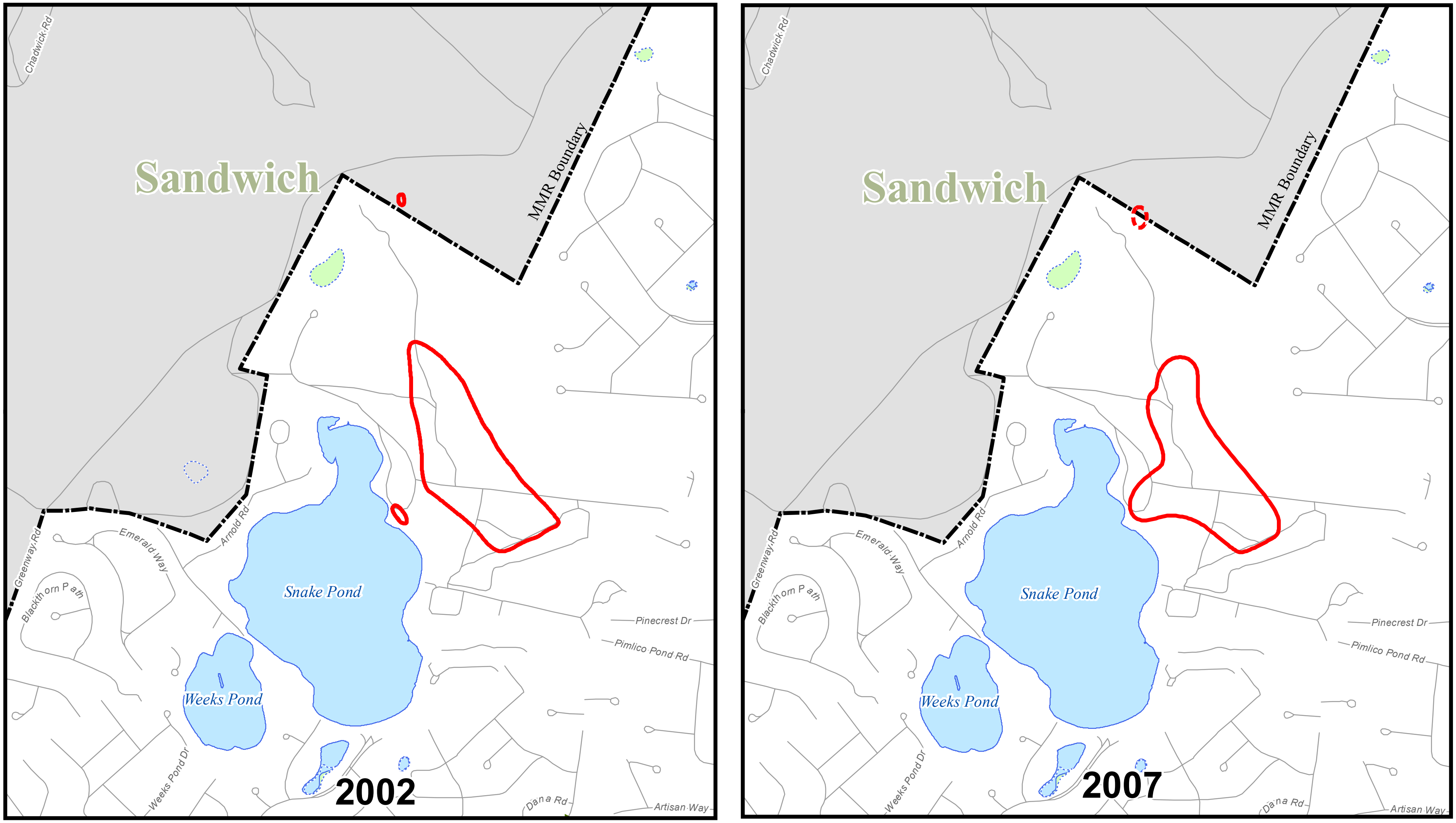

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 800 1,600 Feet

FIGURE 4-9

FS-12 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation
5 Year Review

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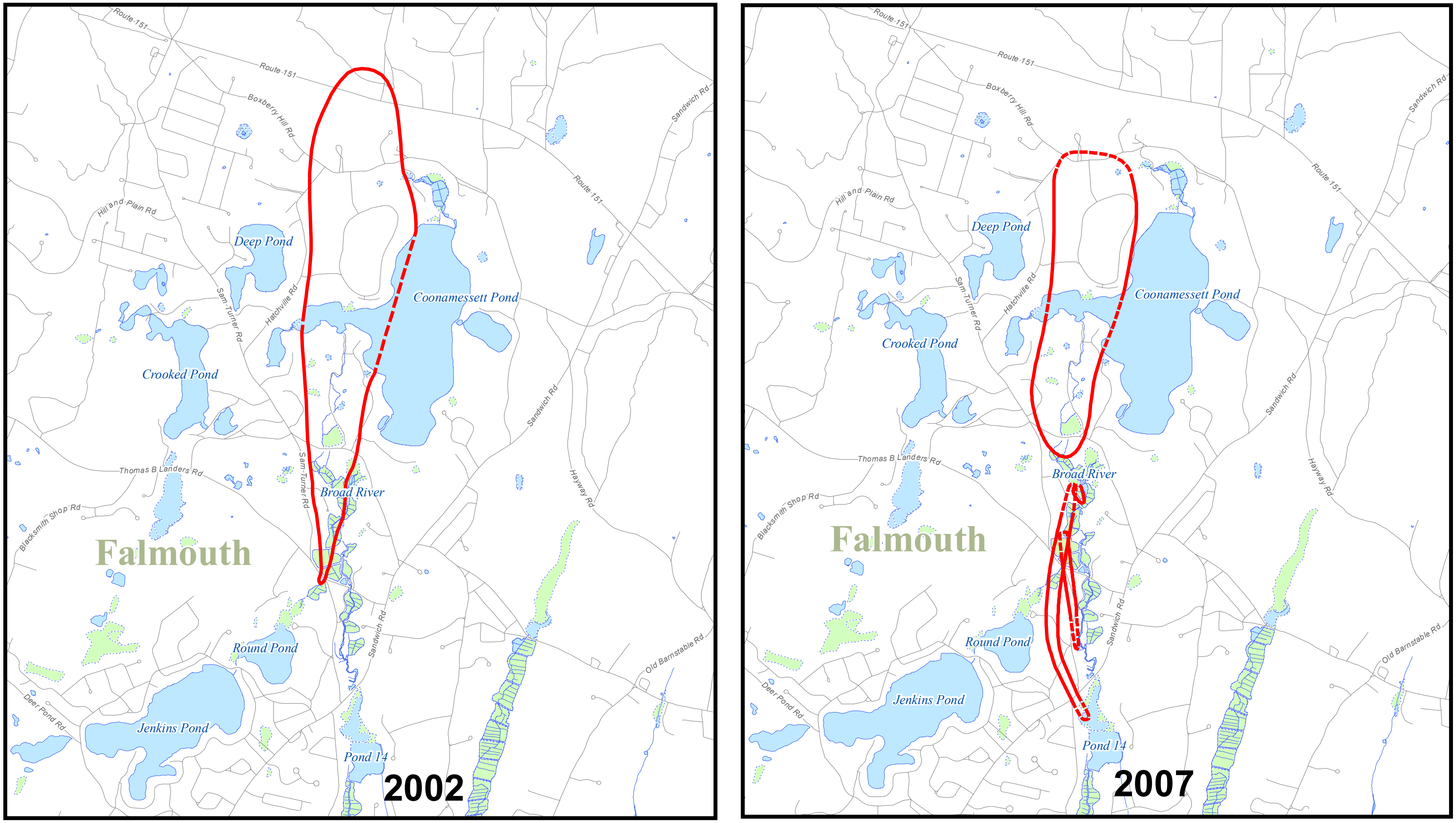

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,500 3,000 Feet

FIGURE 4-10

FS-28 PLUMES
2002 AND 2007 COMPARISON
AFCEE - Massachusetts Military Reservation
5 Year Review

CH2MHILL

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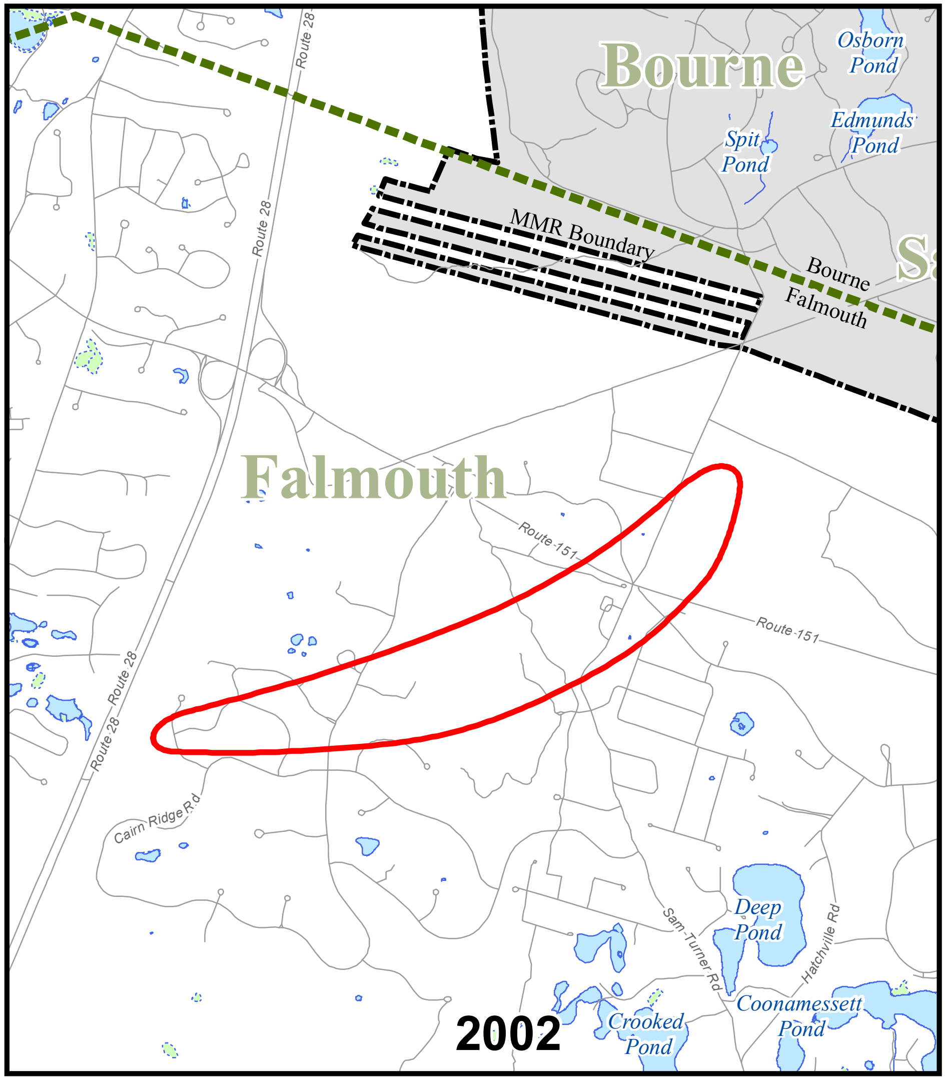

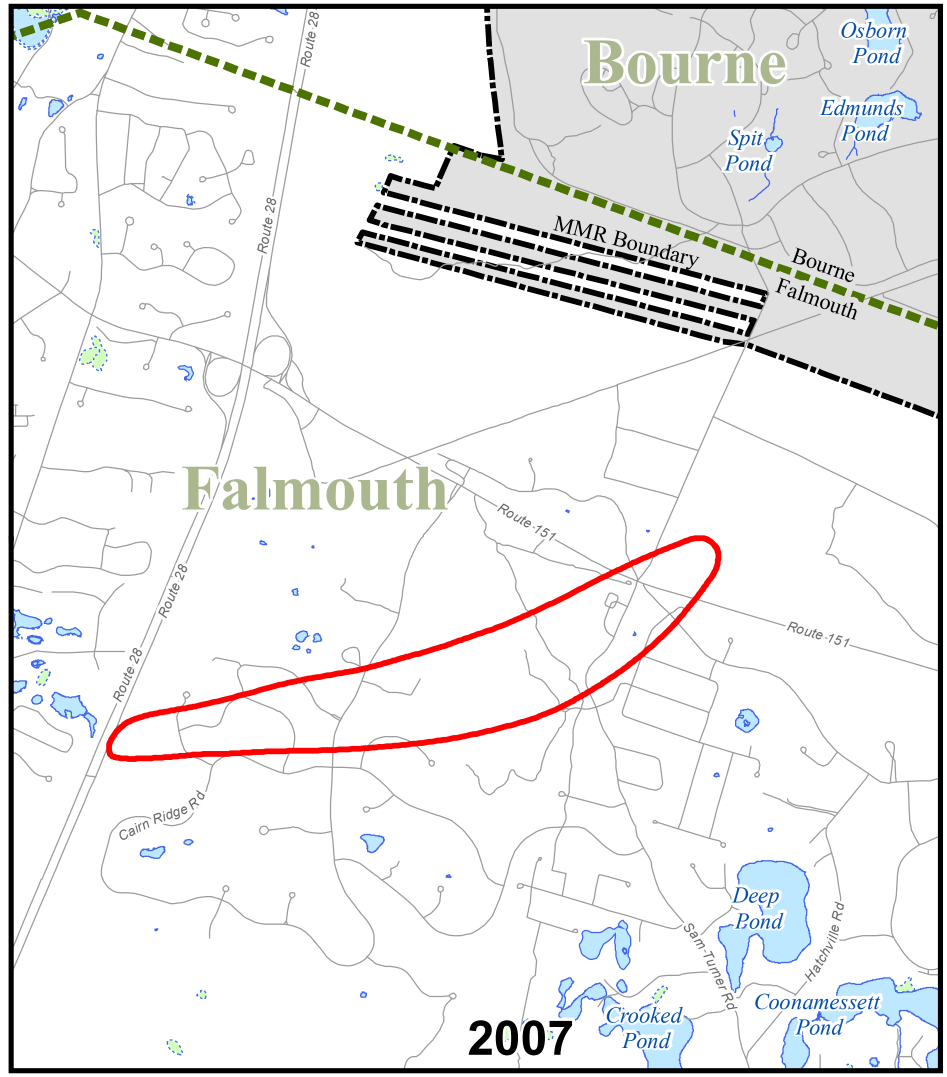

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,400 2,800 Feet

FIGURE 4-11

FS-29 PLUMES
2002 AND 2007 COMPARISON
AFCEE - Massachusetts Military Reservation
5 Year Review

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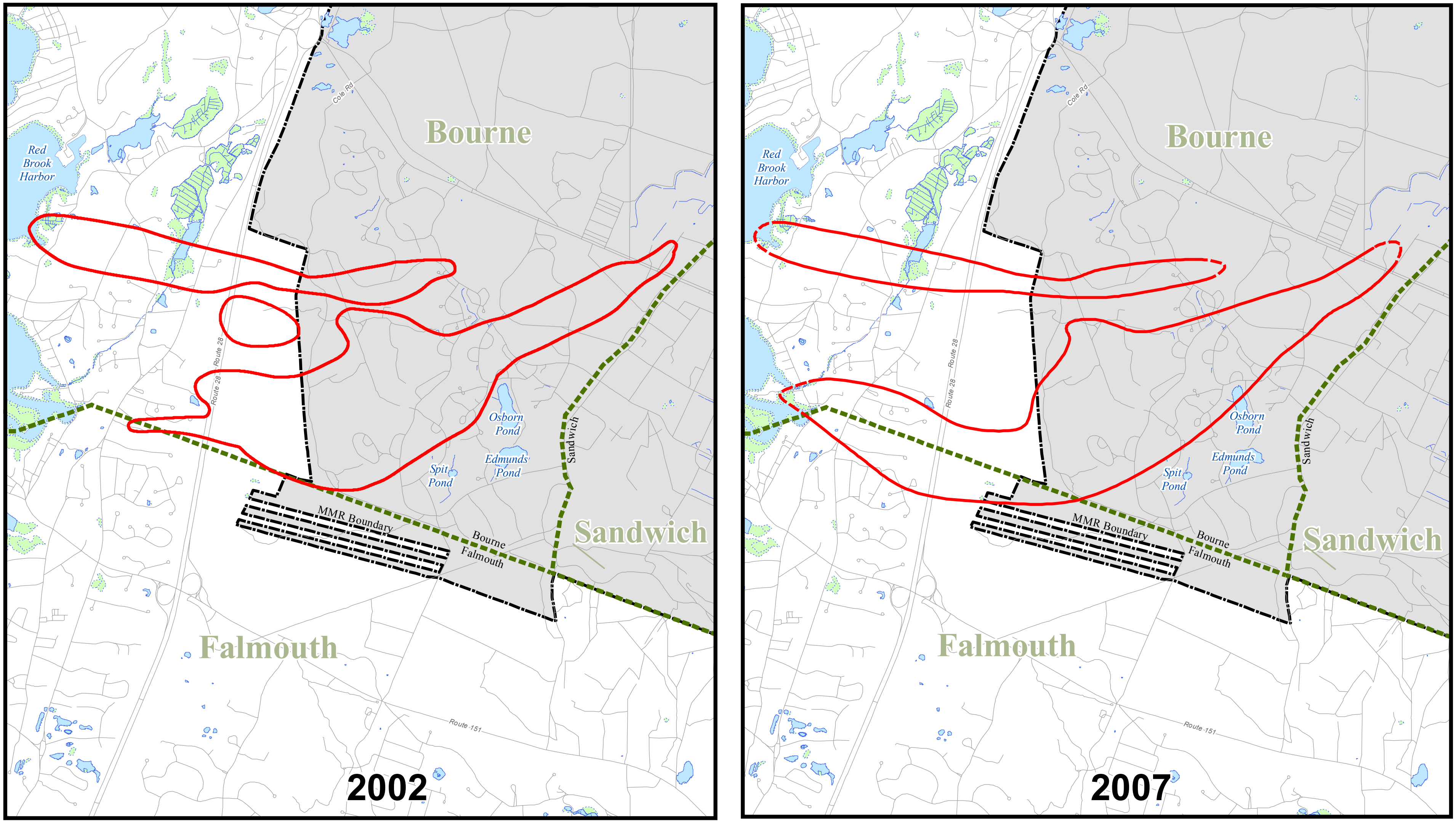

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 2,000 4,000 Feet

FIGURE 4-12

LF-1 PLUMES
2002 AND 2007 COMPARISON
AFCEE - Massachusetts Military Reservation
5 Year Review

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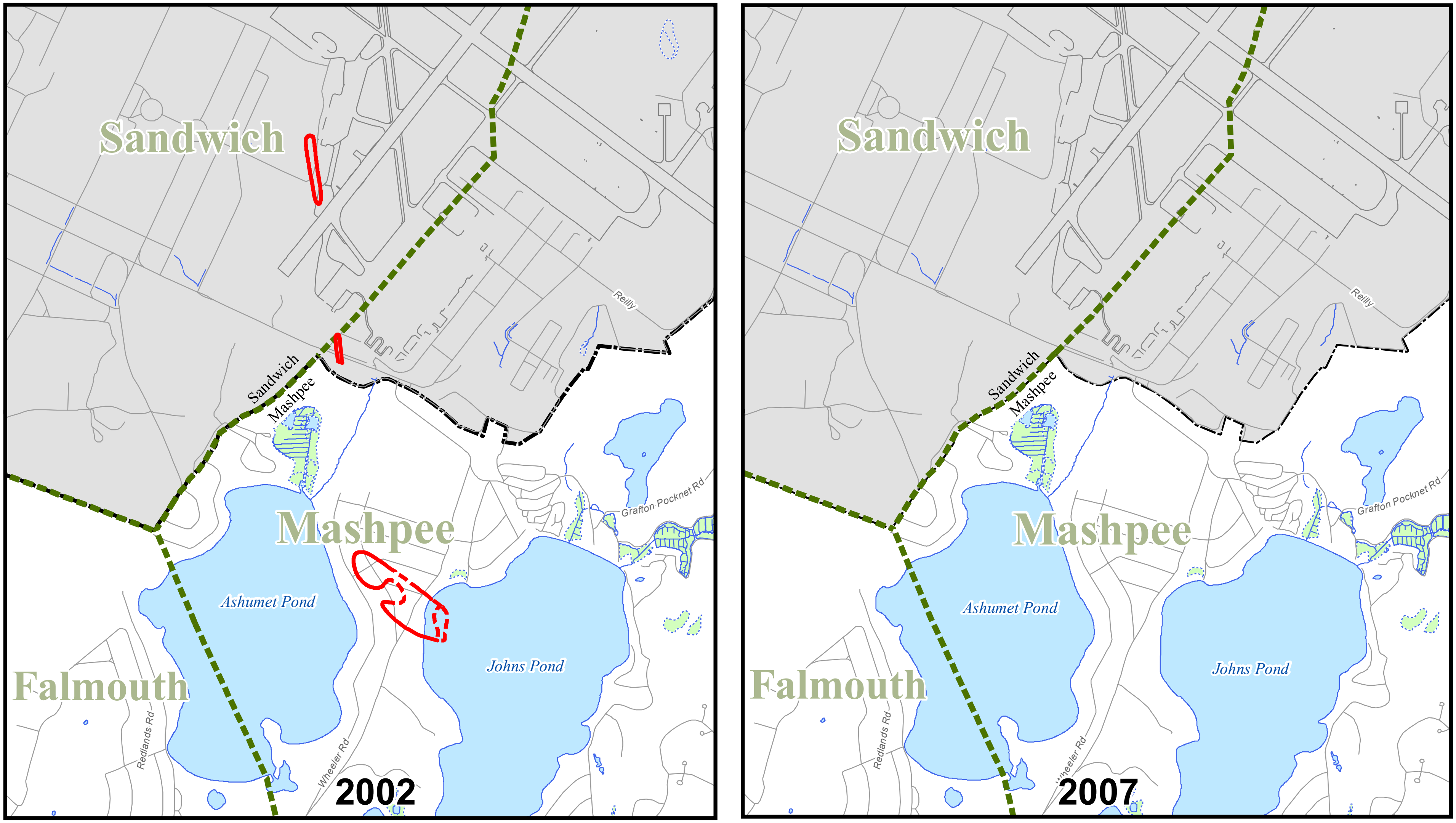

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

Note: COC concentrations in groundwater did not exceed applicable standards in 2007 therefore a plume boundary is not depicted.

N

0 1,100 2,200 Feet

FIGURE 4-13

SD-5 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

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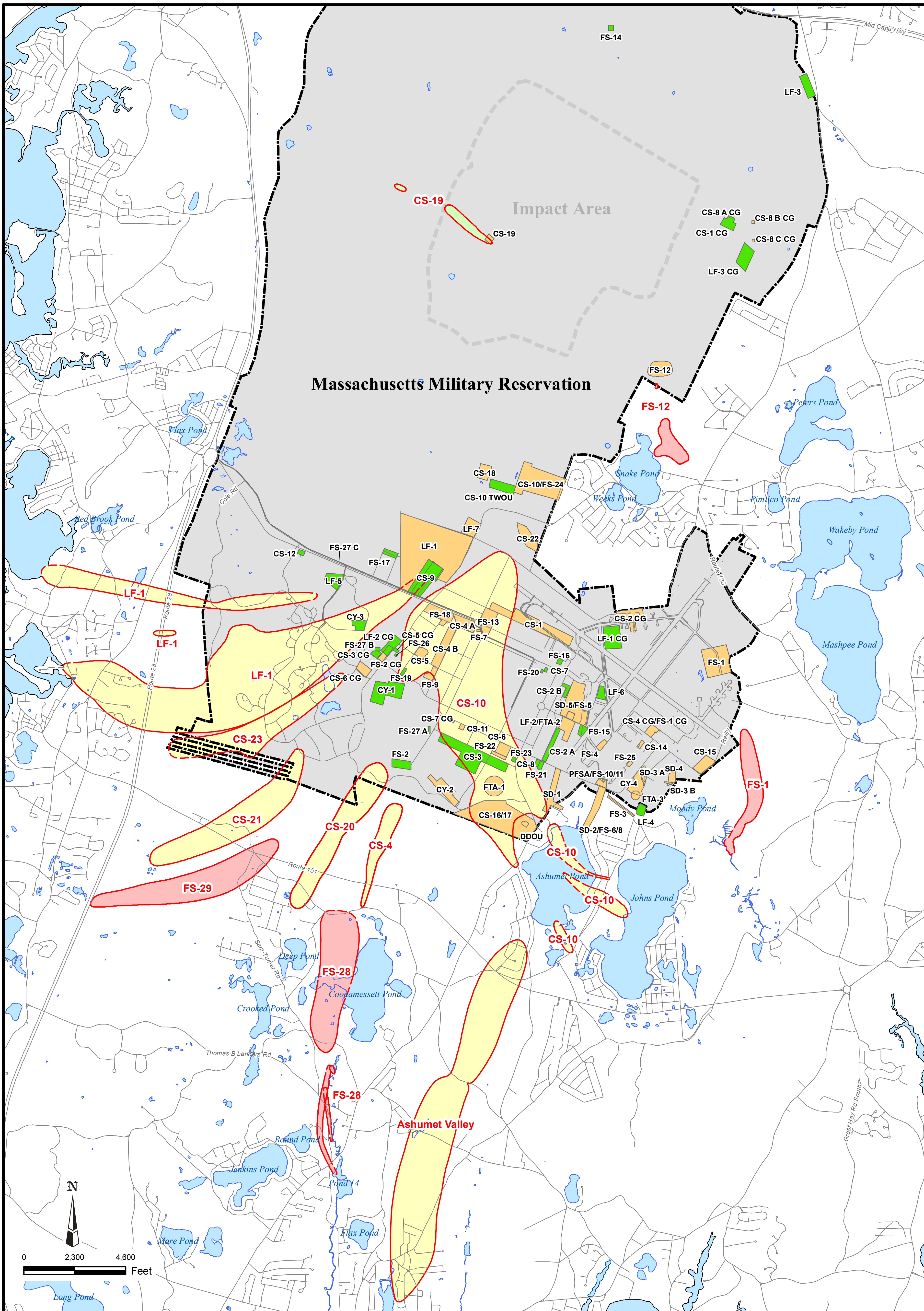
LIST OF FIGURES



Data Source: AFCEE, MMR-AFCEE Data Warehouse

Legend

- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Impact Area
- Source Areas Undergoing 5-Year Review
- Source Areas - No Further Action Sites
- EDB Plume - Represent an exceedance of Ethylene Dibromide (1,2-dibromoethane), EDB MMCL = 0.02 µg/L
- TCE Plume - Represent an exceedance of Trichloroethene (TCE), TCE MCL = 5.0 µg/L
- Explosives Plume Concentrations Above EPA Health Advisory Levels, Royal Demolition Explosive (RDX) GW-1 standard = 1 ppb

FIGURE 1-1

ALL MMR - IRP SITES

AFCEE - Massachusetts Military Reservation
5 Year Review

CH2MHILL

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What is Superfund?
Superfund is the nickname for the environmental cleanup program legally known as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a federal law, enacted in 1980. Superfund provides the authority through which the Federal government can compel people or companies responsible for creating hazardous waste sites to clean them up. It also created a public trust fund, known as the Superfund, to assist with the cleanup of inactive and abandoned hazardous waste sites or accidentally spilled or illegally dumped hazardous materials.

See also EPA's Superfund Internet Resources
Superfund Process:
http://www.epa.gov/superfund/action/process/sfprocess.htm
General Superfund:
http://www.epa.gov/superfund/index.htm

Site Discovery → Preliminary Assessment/ Site Inspection → Hazard Ranking System → Is immediate action needed?

Yes → Removal Action → Action Memorandum

EPA has three categories of removal actions, emergency, time-critical, and non-time-critical. Removal actions are taken to eliminate extreme hazards at a site (I.e., chemical tanker fire) and/or provide short-term solutions such as providing drinking water while the site is more thoroughly investigated and evaluated, and more permanent solutions are developed in the RI/FS and cleanup occurs after a Record of Decision is finalized.

No → Remedial Investigation Report → Feasibility Study → Proposed Plan → Record of Decision →

to: Remedial Design →

Remedial Investigation Report: Presents the nature and extent of contamination, evaluates human health and ecological risk

Feasibility Study: Presents cleanup alternatives where each is evaluated using EPA's nine criteria (i.e., protection of human health and environment, cost, implementability, etc.)

Proposed Plan: Presents the preferred cleanup alternative and is issued for a 30-day public comment period

Record of Decision: Contains the selected remedy for a site and the Responsiveness Summary which provides responses to all comments received during the public comment period

Figure 1-2: Overview of Superfund Investigation & Cleanup Process

LEGEND: Decision Point; Document; Process

from: Record of Decision → Remedial Design → Remedial Action, Long-term Monitoring, and Operation & Maintenance → Five-Year Review → Site Deletion

Five-Year Review → Five-Year Review Report

For groundwater cleanups at MMR, these are the three major documents that are prepared.
A description of each document is provided.

Interim Remedial Action Report: Interim Remedial Action Reports are prepared to document the system that is built and presents monitoring, operation, and maintenance activities

Annual System Performance Ecological Impact Monitoring Report: As part of long-term monitoring, AFCEE at MMR submits these annual reports for each treatment system which evaluates the treatment system and its performance. Recommendations for optimizing the system and monitoring are presented.

Final Remedial Action Report: Groundwater cleanups at MMR will take up to 30 or more years to complete and reach cleanup levels. Once cleanup levels are achieved, then a Final RA Report is prepared to document the cleanup.

During remedial design for groundwater cleanups at MMR, additional data is collected to further define the contamination and used to model groundwater cleanup systems.

Wellfield Design Project Note: To expedite the approval process for a design, AFCEE obtains regulatory approval to construct systems using the Wellfield Design Project Note which is a brief summary of the wellfield design for groundwater cleanups, and includes the location of all extraction and reinjection wells, and their respective extraction/discharge rates.

After all sites on a Superfund Site are investigated and cleanup levels have been achieved, the Site can begin the process to delete it from the NPL.

At MMR, the Five Year Review was triggered by start of cleanup at CS-4 groundwater plume in 1993. Current five-year review period is 2002-2007. Next five-year review will be conducted in 2012 for 2007-2012.

This flowchart begins in the upper left with "Site Discovery" and is an overview of the Superfund process. A site is added to the National Priorities List and is called a Superfund Site if it has a score of 28.5 or greater using the a scoring system which is called the Hazard Ranking System. Since the investigation and cleanup process takes several years, sites are evaluated early in the process to determine if any short-term actions or removal actions need to be taken. Details are provided in comments associated with certain steps in the flowchart. Typical Superfund sites have only one to three operable units and are smaller in comparison to federal facility sites such as the Massachusetts Military Reservation (MMR) which has 80 sites in its Installation Restoration Program (IRP).

Figure 1-2, continued: Overview of Superfund Investigation & Cleanup Process

LEGEND: Decision Point; Document; Process

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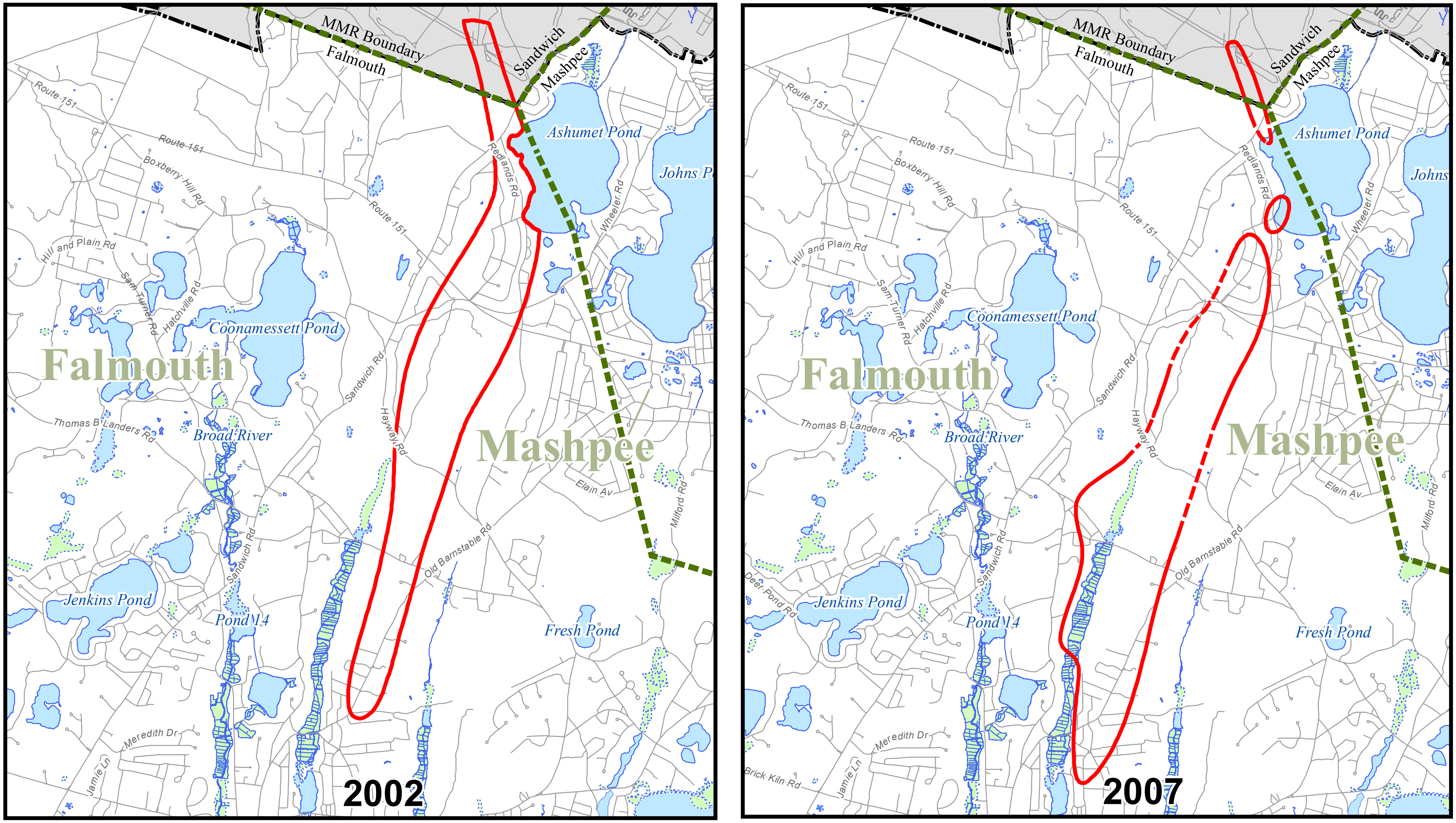

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 2,250 4,500 Feet

FIGURE 4-1

ASHUMET VALLEY PLUMES 2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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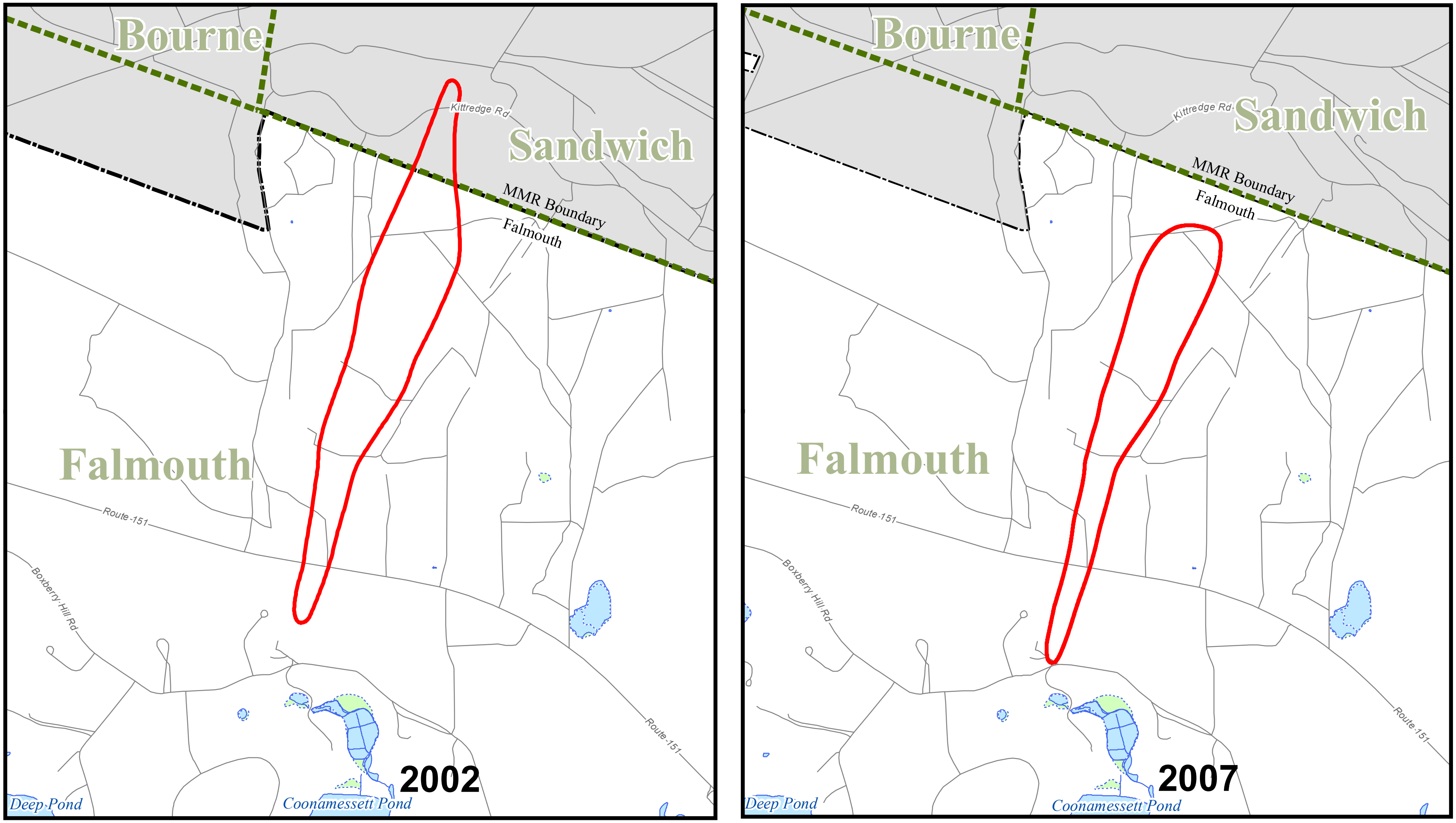


Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 790 1,580 Feet

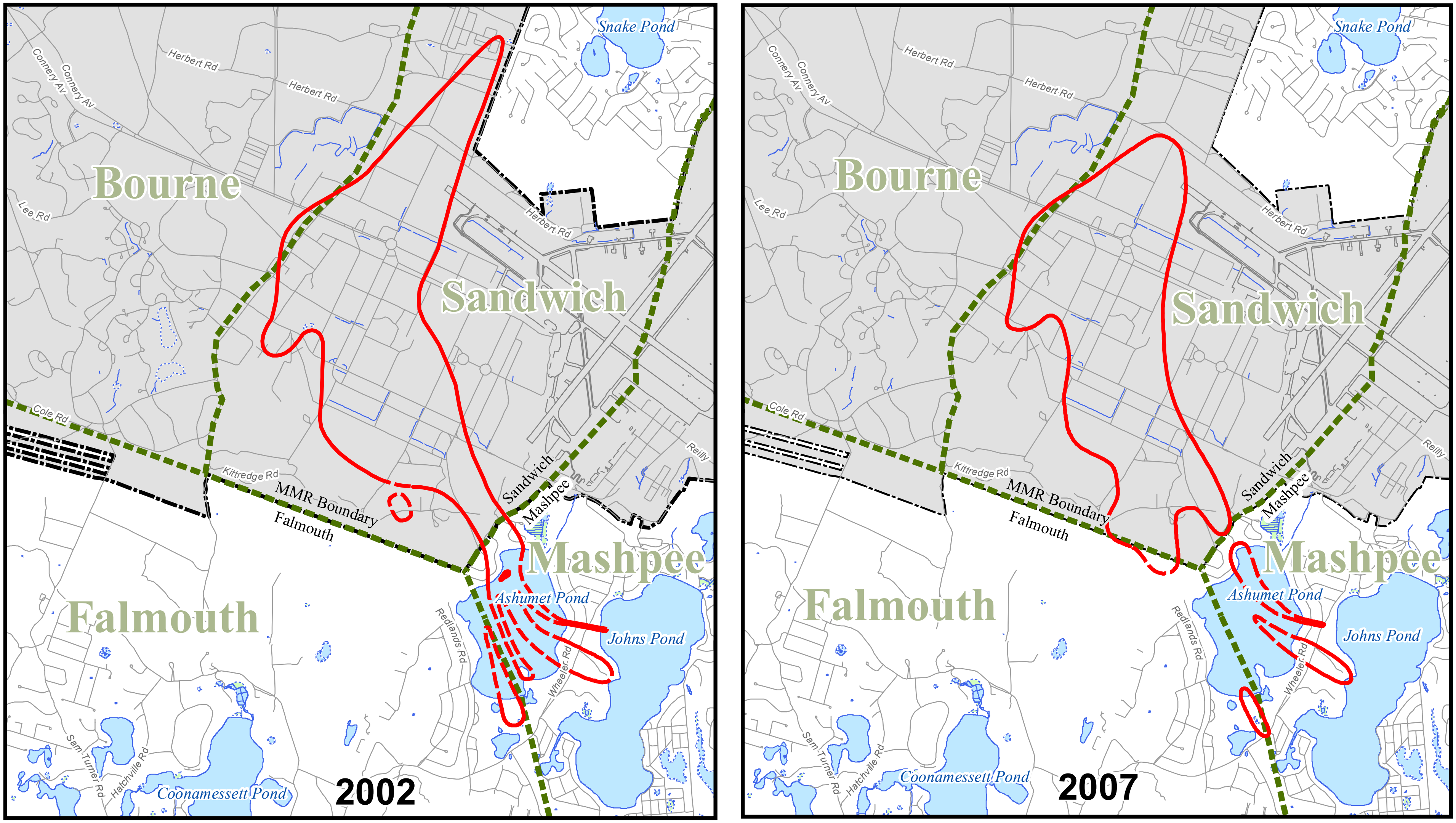
FIGURE 4-2

CS-4 PLUMES 2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL



Legend

Town Boundary

Massachusetts Military Reservation Boundary

Plume Boundary (Dashed Where Inferred)

Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 2,250 4,500 Feet

FIGURE 4-3

CS-10 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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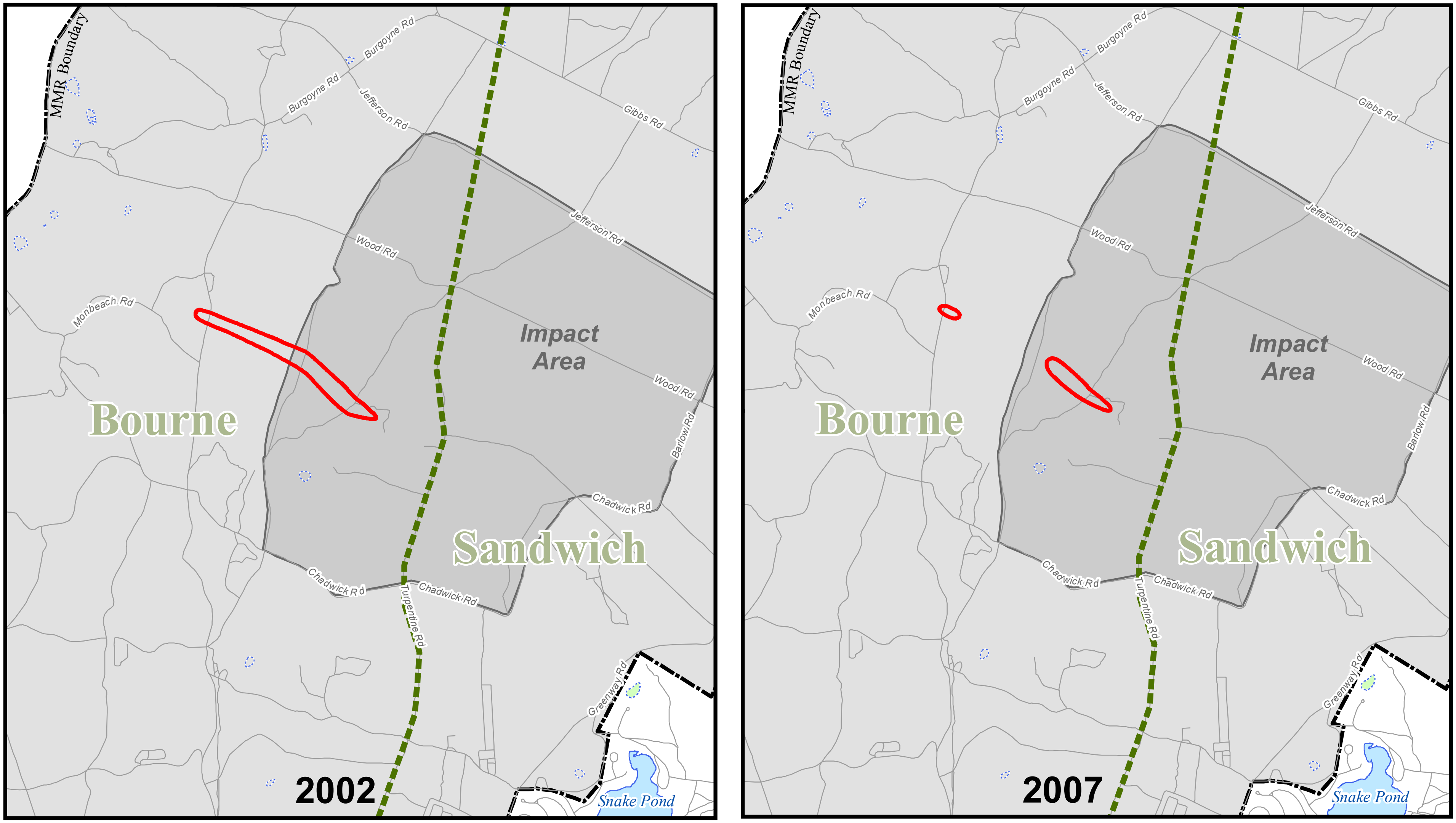

Legend

Town Boundary

Massachusetts Military Reservation Boundary

Plume Boundary

Bog/Wetland

Impact Area

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,900 3,800 Feet

FIGURE 4-4

CS-19 PLUMES 2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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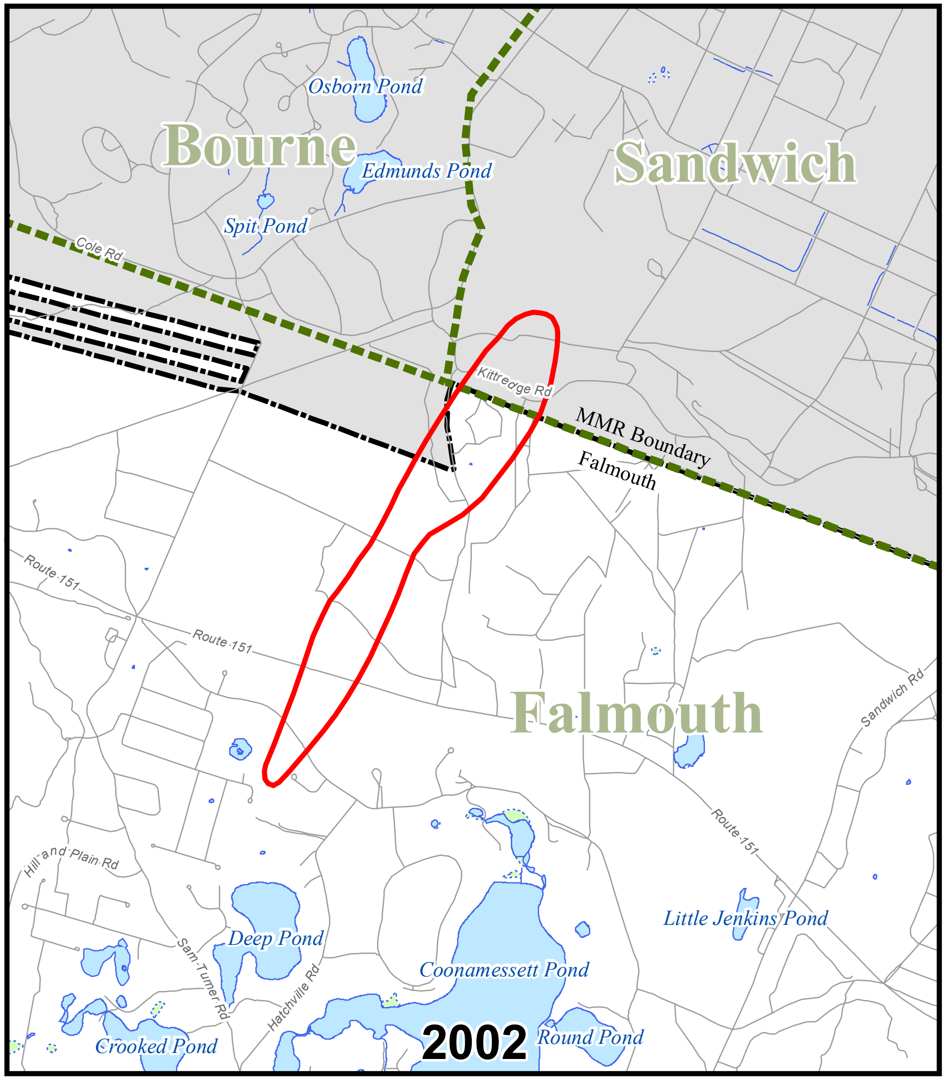

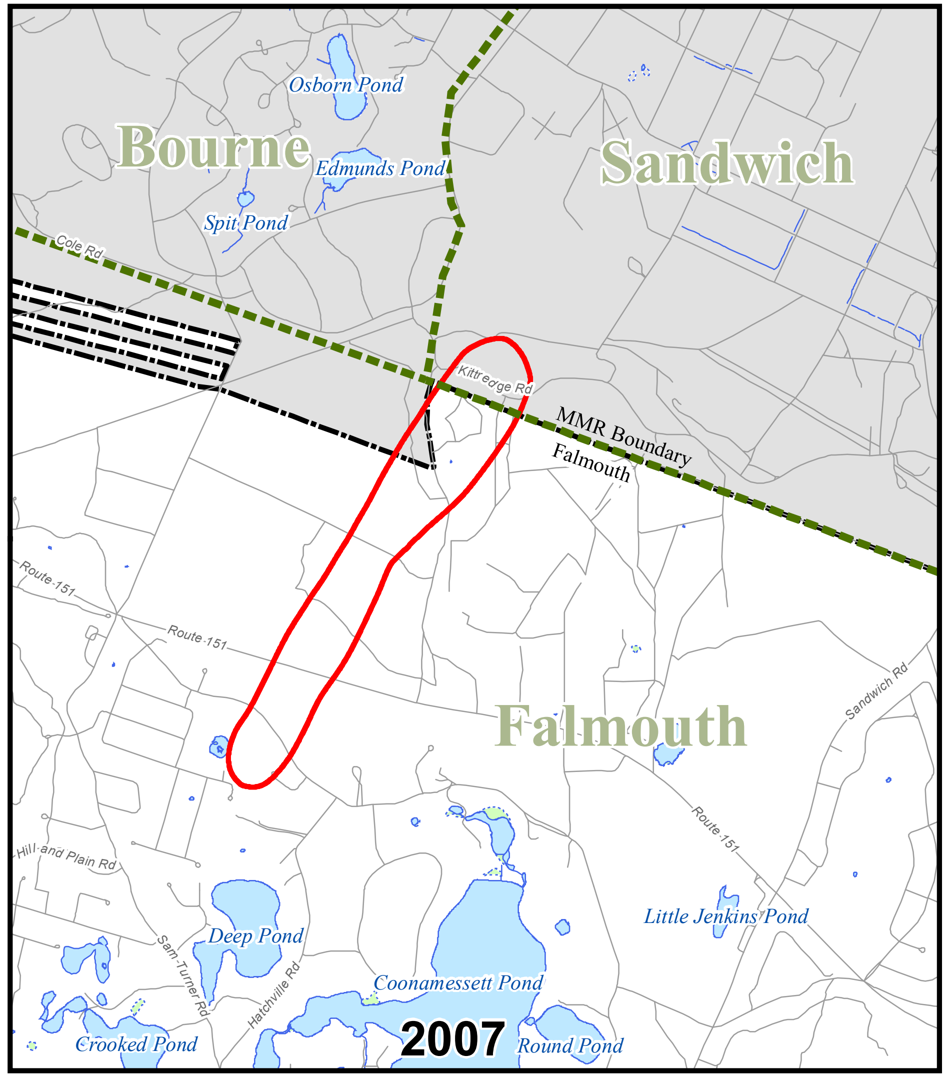

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,400 2,800 Feet

FIGURE 4-5

CS-20 PLUMES 2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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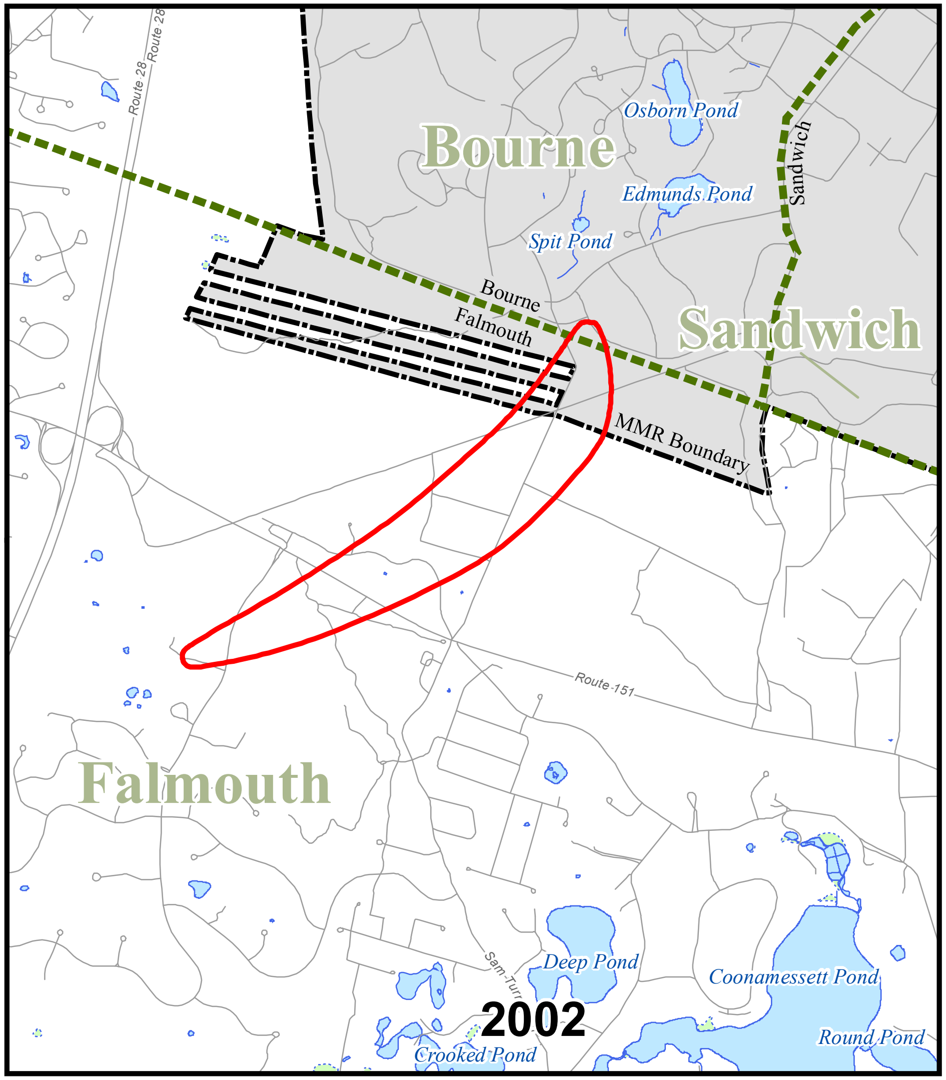

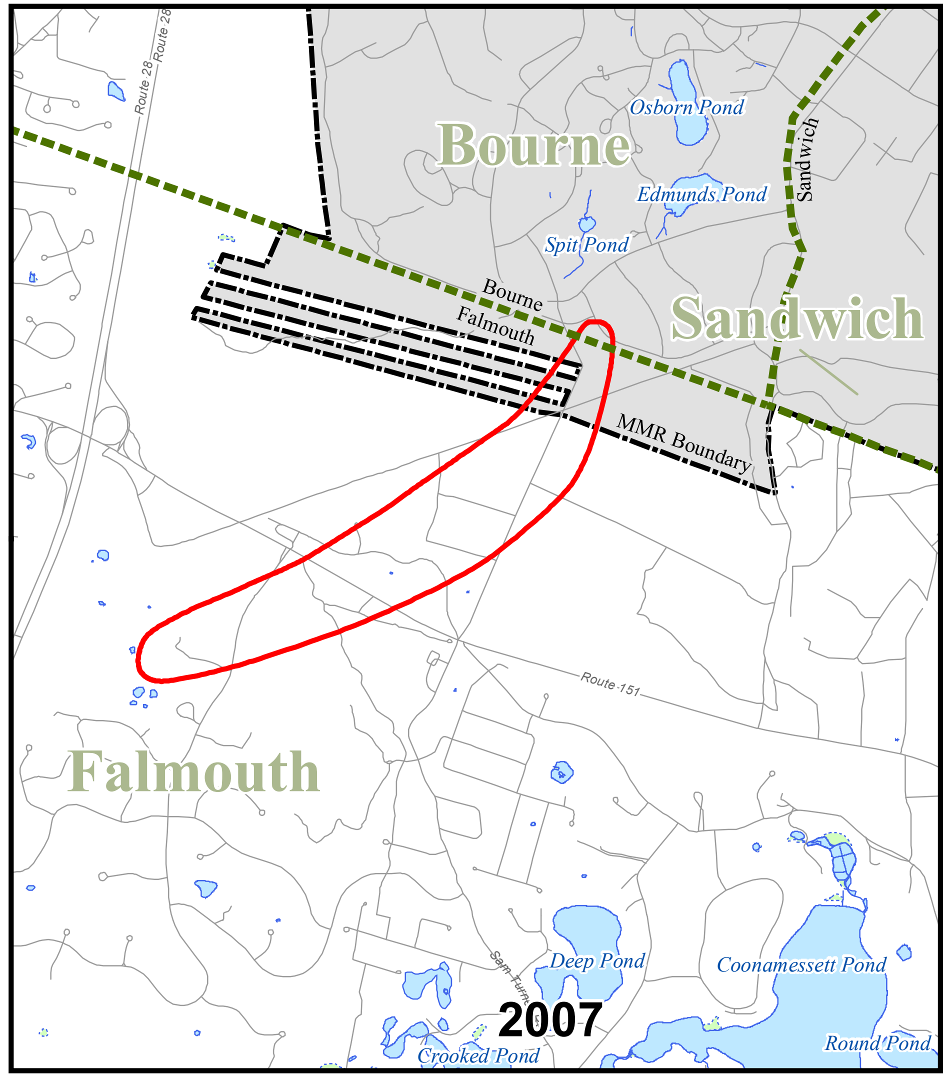

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,400 2,800 Feet

FIGURE 4-6

CS-21 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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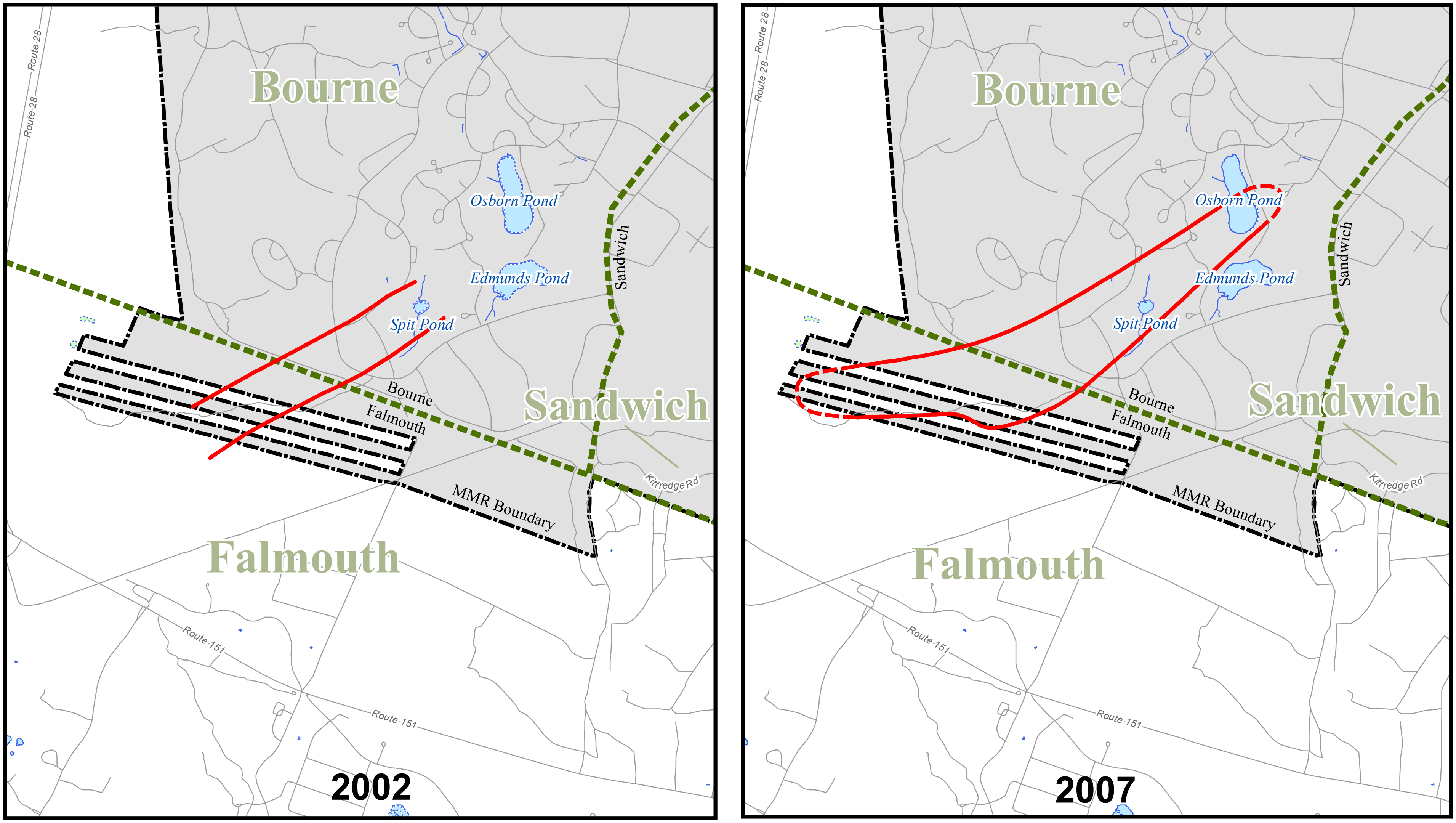

Legend

Town Boundary

Massachusetts Military Reservation Boundary

Plume Boundary (Dashed Where Inferred)

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,300 2,600 Feet

FIGURE 4-7

CS-23 PLUMES 2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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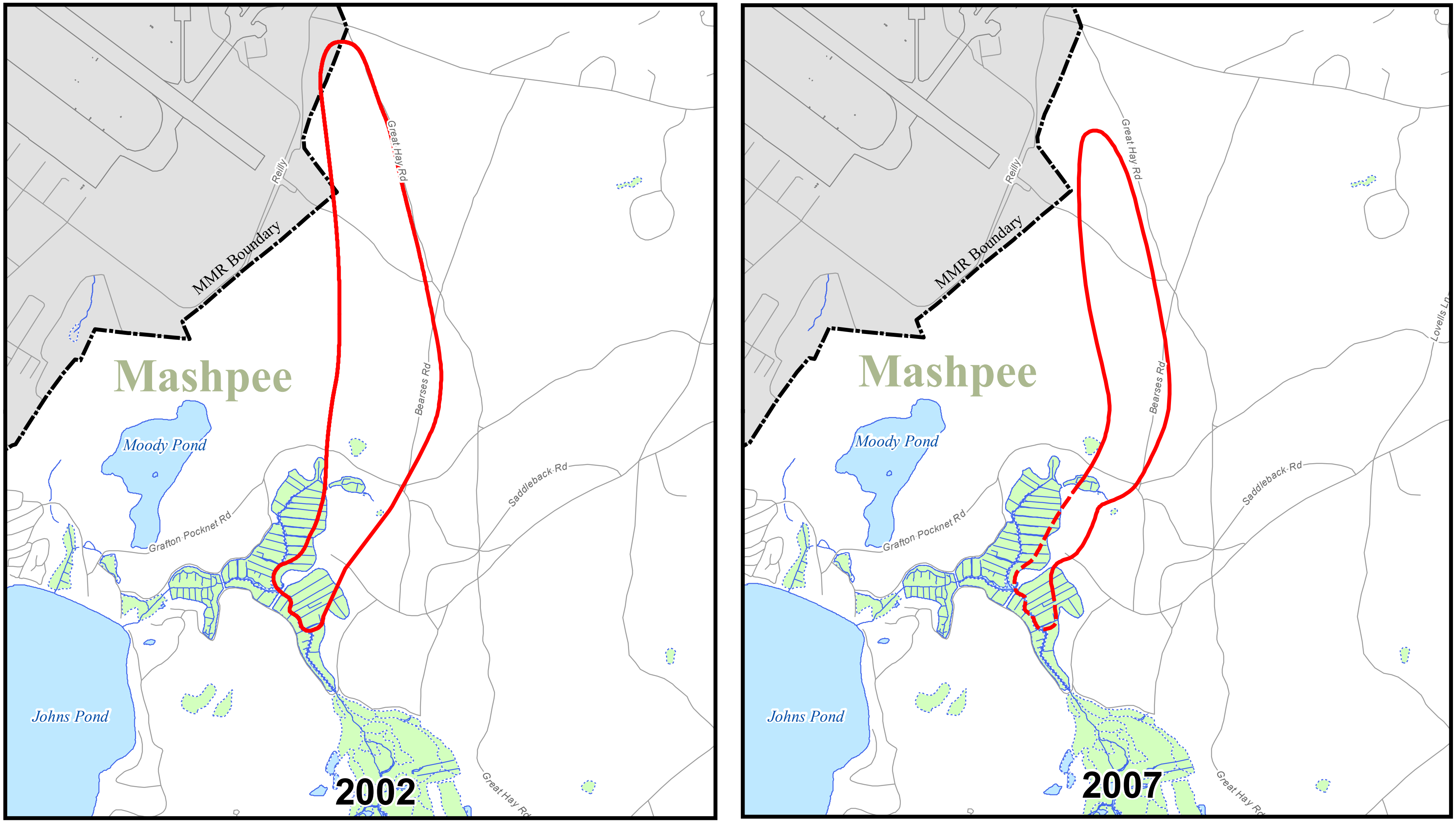

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 840 1,680 Feet

FIGURE 4-8

FS-1 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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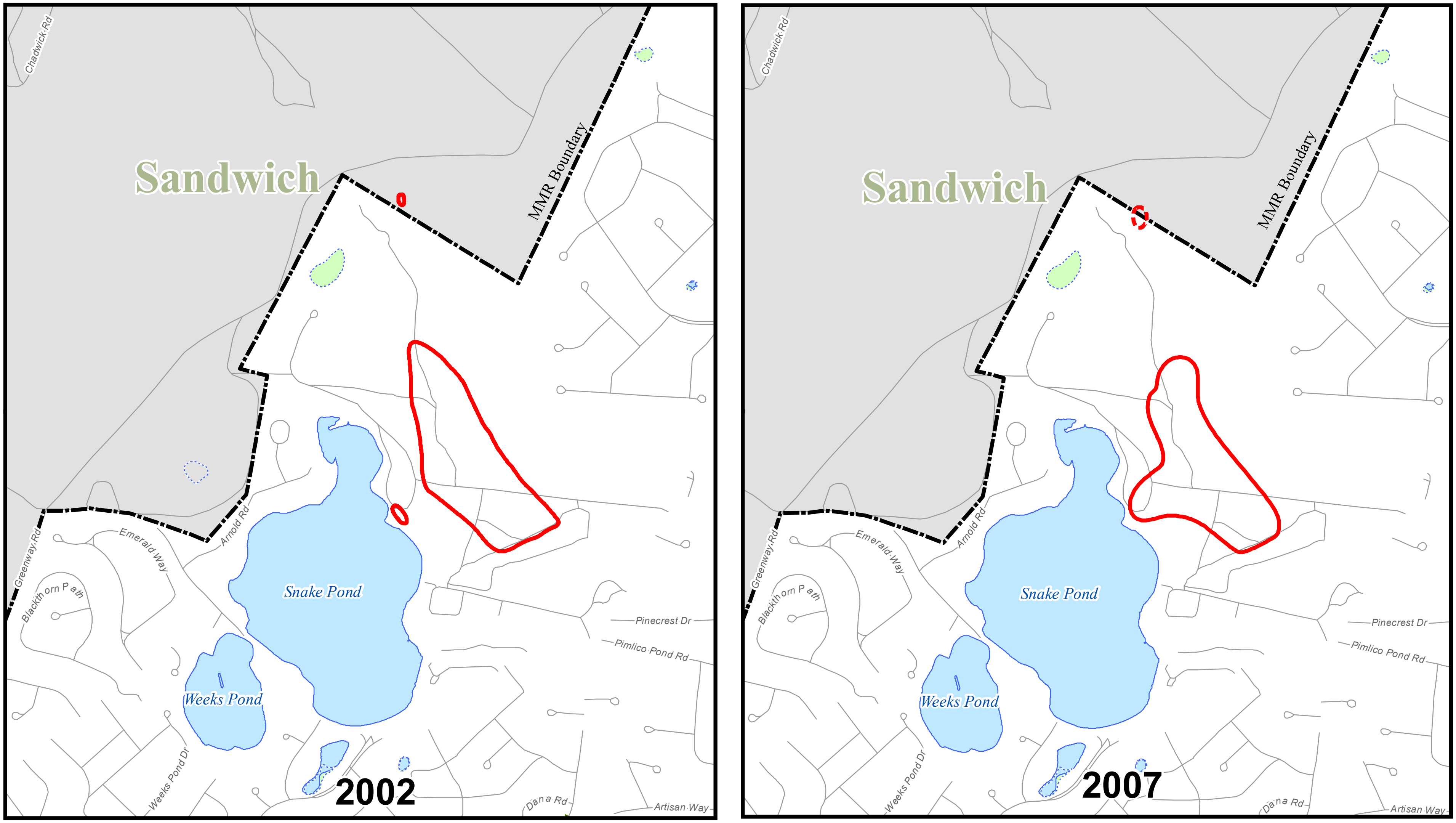

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 800 1,600 Feet

FIGURE 4-9

FS-12 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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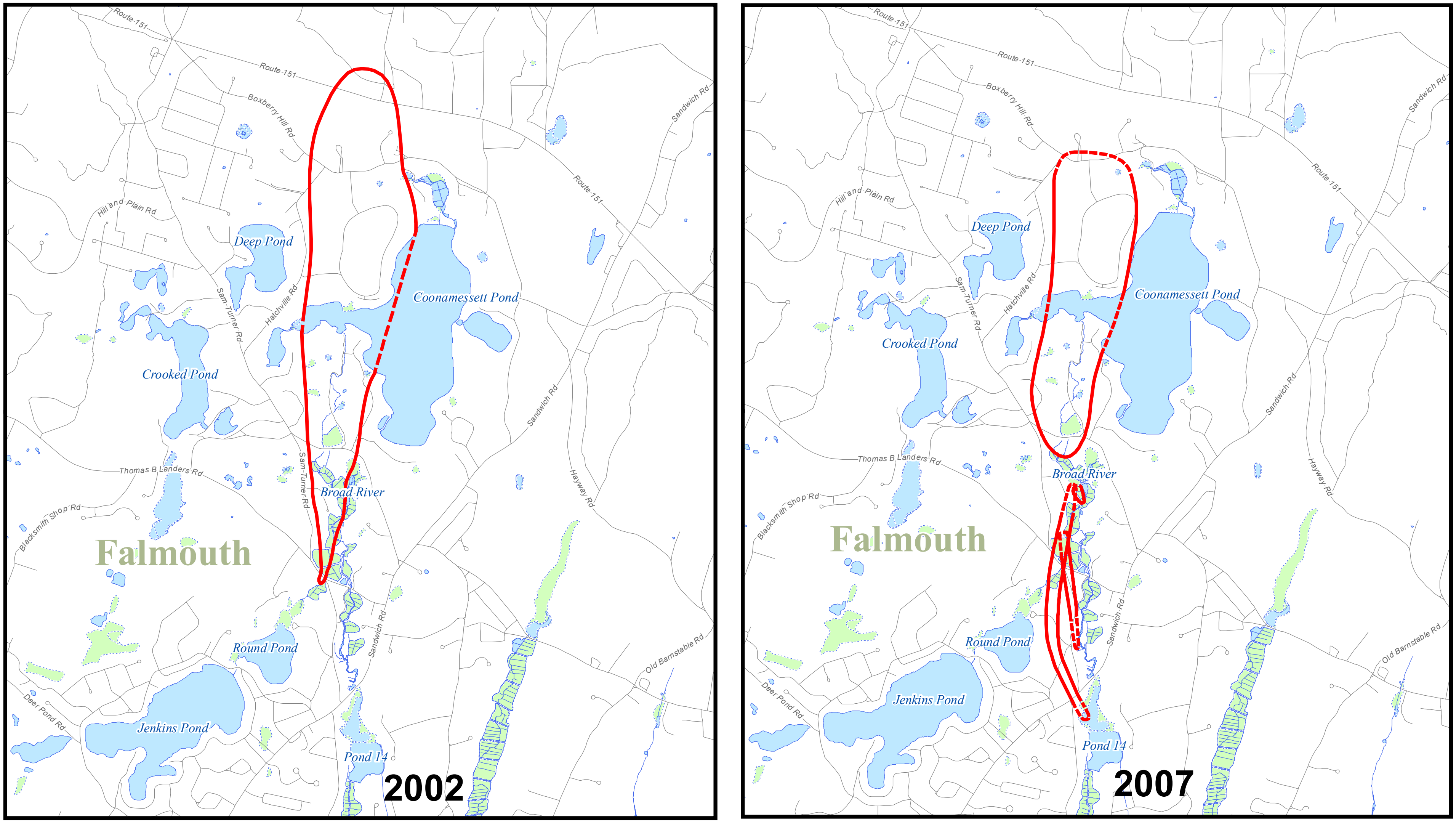

Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,500 3,000 Feet

FIGURE 4-10

FS-28 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

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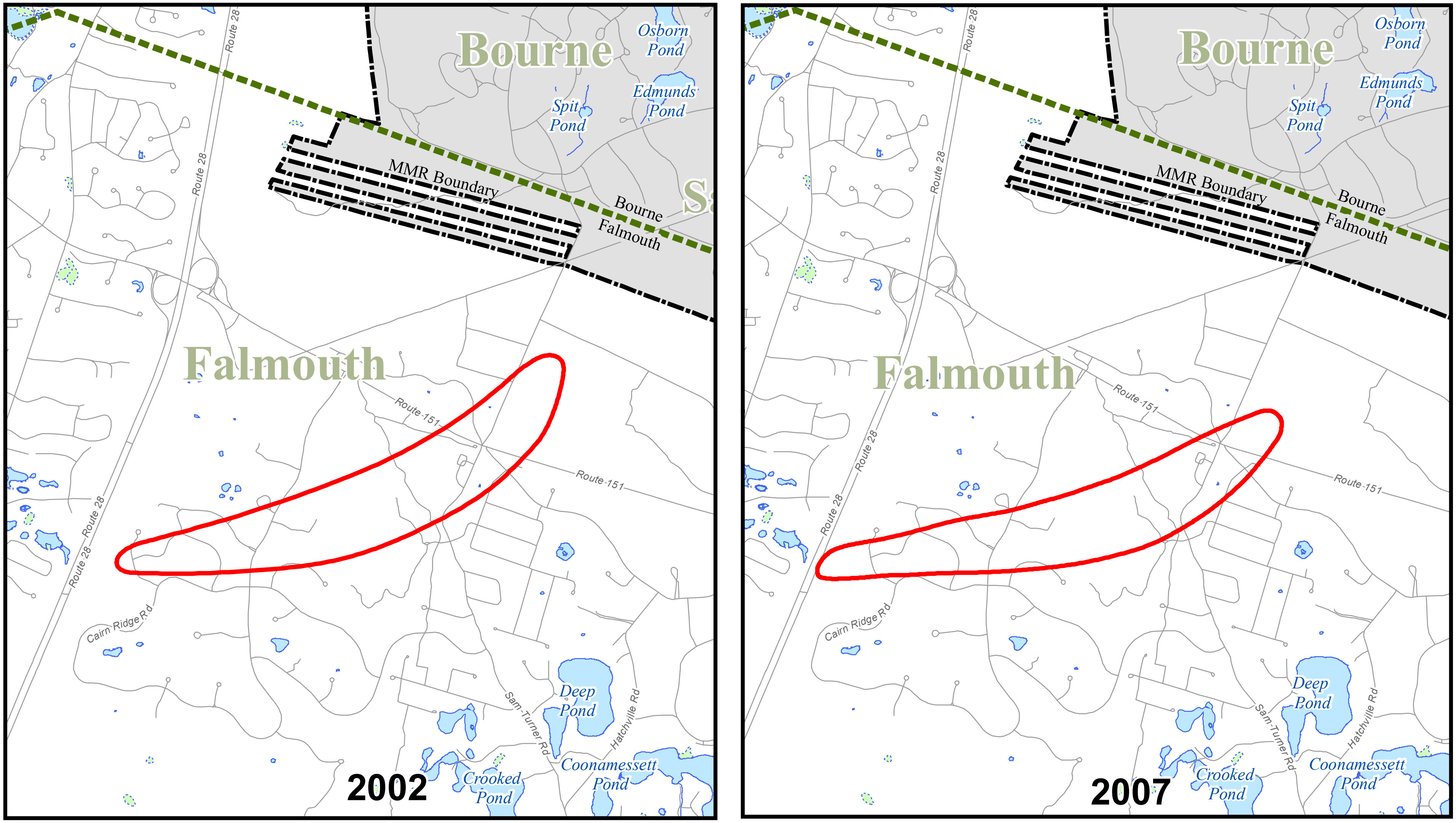

Legend

Town Boundary

Massachusetts Military Reservation Boundary

Plume Boundary

Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

0 1,400 2,800 Feet

FIGURE 4-11

FS-29 PLUMES
2002 AND 2007 COMPARISON
AFCEE - Massachusetts Military Reservation
5 Year Review

CH2MHILL

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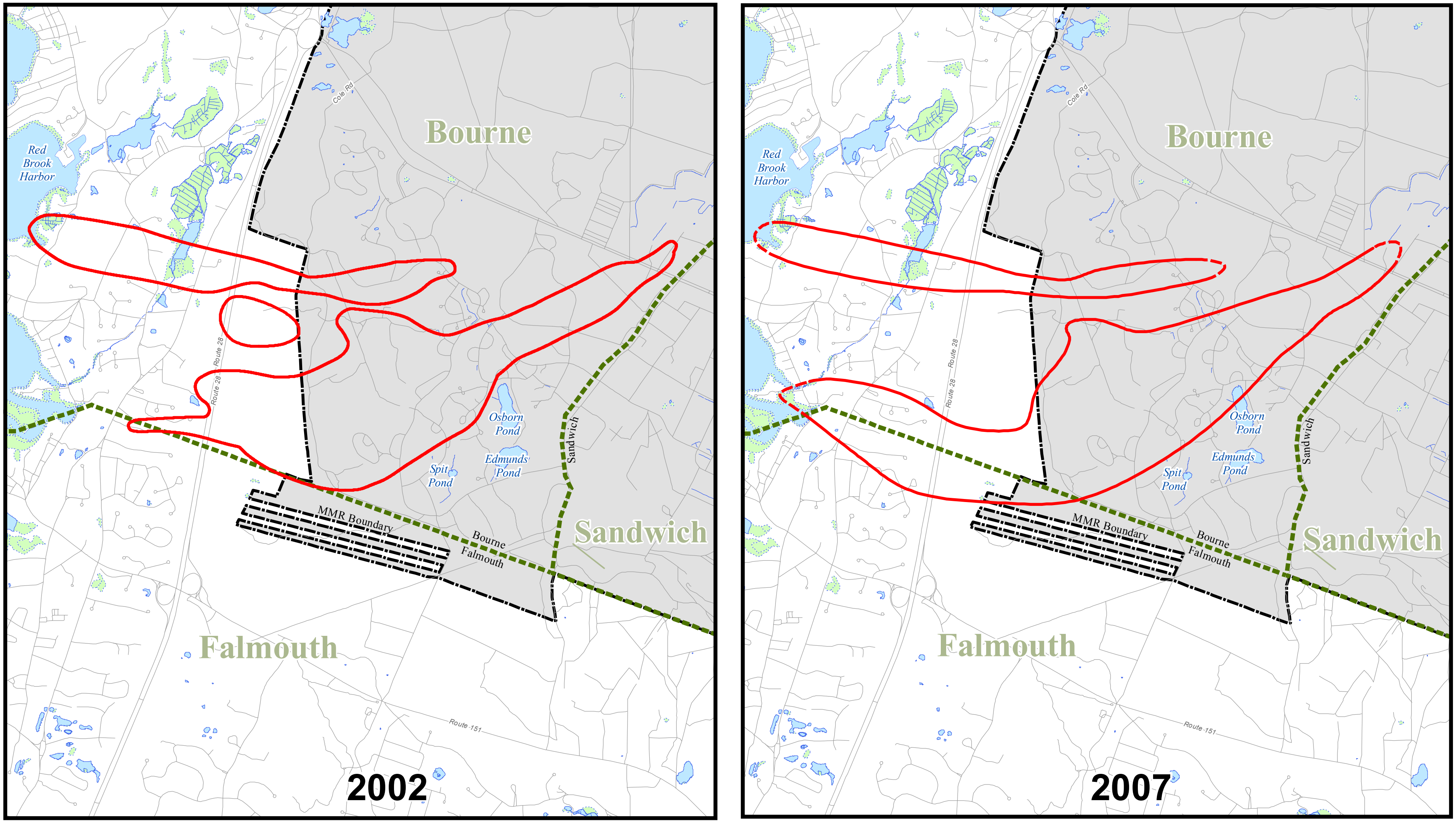


Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

N

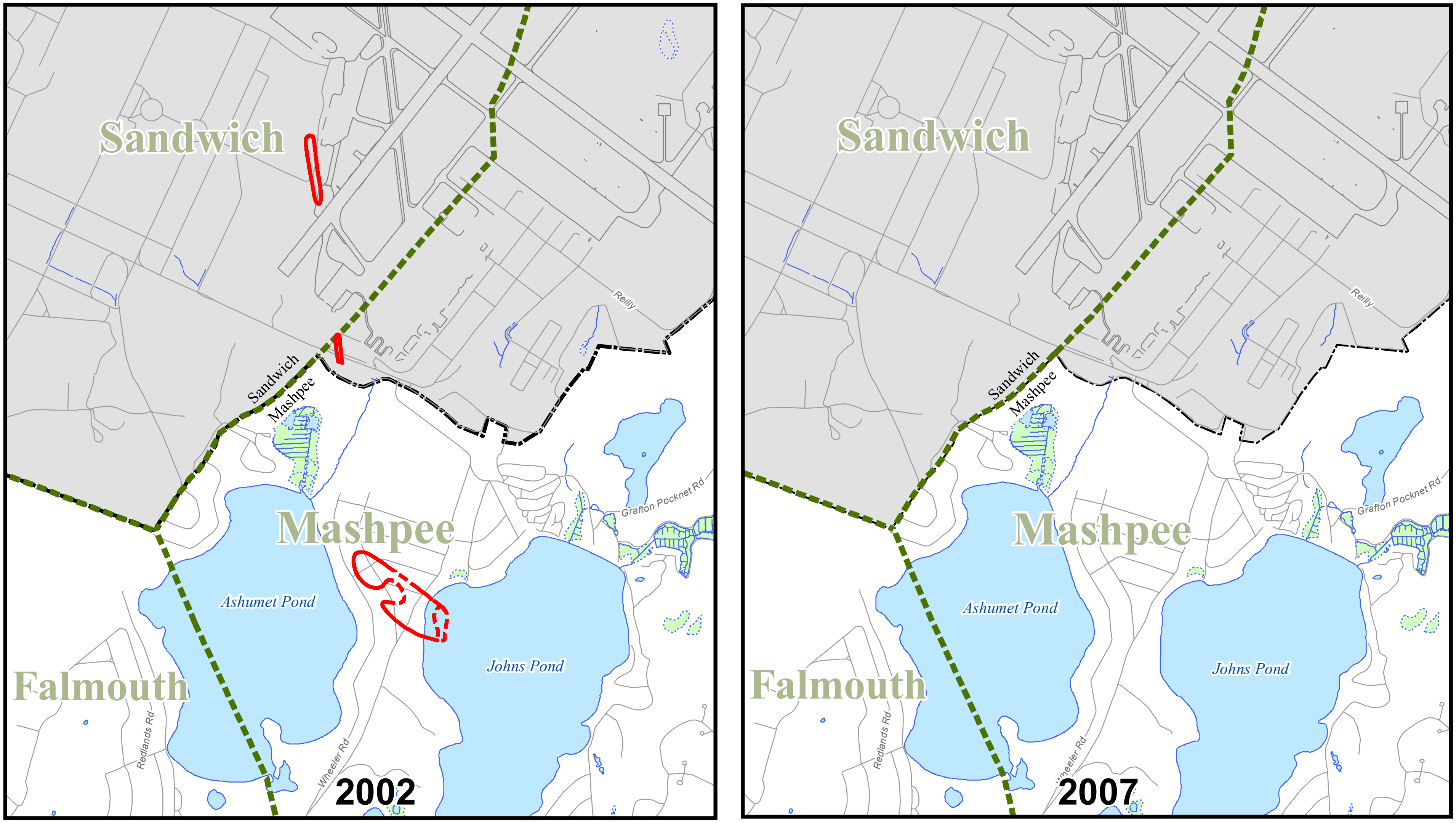
0 2,000 4,000 Feet

FIGURE 4-12

LF-1 PLUMES
2002 AND 2007 COMPARISON
AFCEE - Massachusetts Military Reservation
5 Year Review

CH2MHILL

Last Opened 7/21/2008 11:50:46 AM by SD Y:\Figures\General\Alves\2008\5year\GIS\Arcmap\08FiveYr_SD-5comp_Fig04-13.mxd



Legend

- Town Boundary
- Massachusetts Military Reservation Boundary
- Plume Boundary (Dashed Where Inferred)
- Bog/Wetland

Data Source: AFCEE, MMR-AFCEE Data Warehouse

Note: COC concentrations in groundwater did not exceed applicable standards in 2007 therefore a plume boundary is not depicted.

N

0 1,100 2,200 Feet

FIGURE 4-13

SD-5 PLUMES
2002 AND 2007 COMPARISON

AFCEE - Massachusetts Military Reservation

5 Year Review

CH2MHILL

Table 1-1
All MMR Source Area and Groundwater Sites

Source Area Sites					
CS-1	CS-8	CY-1	FS-8	FS-22	LF-3 USCG
CS-1 USCG	CS-8 USCG	CY-2	FS-9	FS-23	LF-4
CS-2	CS-9	CY-3	FS-10	FS-24	LF-5
CS-2 USCG	CS-10	CY-4	FS-11	FS-25	LF-6
CS-3	CS-10 TWOU	DDOU	FS-12	FS-26	LF-7
CS-3 USCG	CS-11	FS-1	FS-13	FS-27	PFSA
CS-4	CS-12	FS-1 USCG	FS-14	FTA-1	SD-1
CS-4USCG	CS-14	FS-2	FS-15	FTA-2	SD-2
CS-5	CS-15	FS-2 USCG	FS-16	FTA-3	SD-3
CS-5 USCG	CS-16	FS-3	FS-17	LF-1	SD-4
CS-6	CS-17	FS-4	FS-18	LF-1 USCG	SD-5
CS-6 USCG	CS-18	FS-5	FS-19	LF-2	
CS-7	CS-19	FS-6	FS-20	LF-2 USCG	
CS-7 USCG	CS-22	FS-7	FS-21	LF-3	
Groundwater Sites					
Ashumet Valley	CS-19	CS-23	FS-12	FS-29	Western Aquafarm
CS-4	CS-20	Eastern Briarwood	FS-13	LF-1	
CS-10	CS-21	FS-1	FS-28	SD-5	

Key:
CS = Chemical Spill
DDOU = Drum Disposal Operable Unit
FS = Fuel Spill
LF = Landfill
MMR = Massachusetts Military Reservation
PFSA = Petroleum Fuel Storages Area
TWOU = Tank Wash Operable Unit
USCG = U.S. Coast Guard

Table 1-2
Issue Description and Recommendation/Follow-Up Action

Site #	Issue Description	Issue Summary	Recommendation/ Follow-Up Action	Recommendation/Follow-Up Action Summary	Recommendation Implementation Date	Responsible Party
Source Area Sites						
Multiple IRP Sites (**See Note 1**)	Institutional Controls – other issue	Requirement for LUCs need to determined.	Institutional Controls – Other Recommendation	Evaluate existing access restrictions, land use, implemented remedies, etc., to determine if LUCs are required.	December, 2011	AFCEE
CS-4 USCG/ FS-1 USCG	Change in ARAR/ cleanup levels	The new MassDEP soil standards for benzo(a)pyrene and dibenz(a,h)anthracene could potentially affect the protectiveness of the removal action.	Re-evaluate risk-based cleanup levels	Determine if existing cleanup levels remain protective.	December, 2011	AFCEE
CS-18	Other issue (Uncategorized)	Cleanup levels and confirmation sampling approach have not been established for explosive constituents at CS-18.	Establish cleanup criteria	A final decision regarding CS-18 needs to be made and implemented.	December, 2011	AFCEE
CS-19	Other issue (Uncategorized)	AFCEE and regulatory agencies have agreed to cleanup the source area soil contamination by conducting a non-time critical removal action focusing on eliminating the source of the RDX plume. Cleanup levels have not been established for other explosive constituents at CS-19.	Establish cleanup criteria	A final decision regarding CS-18 needs to be made and implemented.	December, 2011	AFCEE
CY-2	Other issue (Uncategorized)	EPA has not concurred with the no further action Decision Document.	Other recommendations (uncategorized)	EPA needs to review the no further action decision document.	December, 2011	AFCEE
FS-2 USCG	Change in ARAR/ cleanup levels	The new MassDEP soil standards for PAHs could potentially affect the protectiveness of the no further action decision.	Re-evaluate risk-based cleanup levels	Determine if existing cleanup levels remain protective.	December, 2011	AFCEE
FS-7	Change in ARAR/ cleanup levels	The new MassDEP S-1/GW-1 standards for benzo(a)pyrene and dibenz(a,h)anthracene could potentially affect the protectiveness of the removal action.	Re-evaluate risk-based cleanup levels	Determine if existing cleanup levels remain protective.	December, 2011	AFCEE
FTA-2/LF-2	Additional contamination was found	EPH/VPH have been identified as contaminants in subsurface soil and groundwater.	Define extent of additional contamination	Exposure to contaminated groundwater is not an immediate threat to human health based on current land and groundwater use.	December, 2011	AFCEE
LF-1	Other issue (Uncategorized)	ROD did not address NWOU due to former gun position located in same area.	Resolve regulatory approach for gun position	The Air Force, Army, EPA, and MassDEP should develop a plan to resolve the gun position issue on the NWOU with the ultimate objective of modifying the LF-1 remedy decision to include the NWOU cells.	December, 2011	AFCEE
PFSA/FS-10/ FS-11	Additional contamination was found	EPH/VPH have been identified as contaminants in subsurface soil and groundwater.	Define extent of additional contamination	Exposure to contaminated groundwater is not an immediate threat to human health based on current land and groundwater use.	December, 2011	AFCEE
SD-1	Other issue (Uncategorized)	MassDEP raised a concern regarding PAH concentrations in soil.	Conduct risk assessment	AFCEE has a submitted a Project Note to collect soil samples and perform a risk assessment in order to confirm that no further action is required for unrestricted use.	December, 2011	AFCEE
SD-4	Change in ARAR/ cleanup levels	Groundwater may need to be reevaluated. The calculated noncancer HI for groundwater, which is based on residential exposure scenarios, exceeded the EPA threshold of 1.0. Primary contributors include isomers of trimethylbenzene. No further action is required for other media based on results of the RI human health risk assessment, Post-ROD sampling results, and Post-ROD ecological risk analyses.	Re-evaluate risk-based cleanup levels	Trimethylbenzene is classified and regulated by the MassDEP as C_{11}-C_{22} aromatic hydrocarbons.	December, 2011	AFCEE

Table 1-2
Issue Description and Recommendation/Follow-Up Action

Site #	Issue Description	Issue Summary	Recommendation/ Follow-Up Action	Recommendation/Follow-Up Action Summary	Recommendation Implementation Date	Responsible Party
Groundwater Sites						
AV	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
CS-4	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
CS-10	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue and recommendations.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Contaminant plume not contained	The Interim remedial system is not functioning as intended since a portion of the CS-10 plume in the southern trench area has moved beyond the base boundary.	Install additional extraction wells	The Air Force has begun the process to construct an additional extraction well to address the CS-10 southern trench area. Completion of this project is anticipated in late 2008.	December, 2011	AFCEE
CS-19	Changed site condition - Other Issue	Final RAOs should be developed as described in Question B; review of RAOs.	Adjust Remedial Action Objectives prior to insertion in Final ROD	The Interim RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness when the final ROD for CS-19 is developed in 2009.	December, 2011	AFCEE
CS-20	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
CS-21	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
CS-23	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Monitoring - Other	Monitoring and evaluation activities have indicated excessive drawdown of surface water at a nearby wetland and vernal pool.	Continue monitoring	The Air Force will continue to monitor the wetland and vernal pool near CS-23 for potential negative ecological impacts associated with the surface water drawdown.	December, 2011	AFCEE
FS-1	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE

Table 1-2
Issue Description and Recommendation/Follow-Up Action

Site #	Issue Description	Issue Summary	Recommendation/ Follow-Up Action	Recommendation/Follow-Up Action Summary	Recommendation Implementation Date	Responsible Party
FS-12	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
FS-28	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
FS-29	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
LF-1	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Monitoring - Other	Monitoring and evaluation activities have indicated excessive drawdown of surface water at a nearby wetland and vernal pool.	Continue monitoring	The Air Force will continue to monitor the wetland and vernal pool near CS-23 for potential negative ecological impacts associated with the surface water drawdown.	December, 2011	AFCEE
SD-5	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE

Note 1: CS-1, CS-2 USCG, CS-4 USCG/FS-1 USCG, CS-5, CS-6/FS-22, CS-6 USCG, CS-10/FS-24, CS-11, CS-14, CS-15, CS-16/CS-17, CY-1/CY-3, CY-2, DDOU, FS-1, FS-2 USCG, FS-3, FS-4, FS-7, FS-9, FS-12, FS-18, FS-25, FTA-1, FTA-2/LF-2, PFSA/FS-10/FS-11, SD-1, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5.

Key:
AFCEE = Air Force Center for Engineering and the Environment
ARAR = applicable or relevant and appropriate requirement
AV = Ashumet Valley
CS = Chemical Spill
DDOU = Drum Disposal Operable Unit
EPA = U.S. Environmental Protection Agency
EPH = extractable petroleum hydrocarbon
FS = Fuel Spill
FTA = Fire Training Area
HI = hazard index
IRP = Installation Restoration Program
LF = Landfill
LUC = Land Use Control
MassDEP = Massachusetts Department of Environmental Protection
NWOU = Northwest Operable Unit
PAH =polynuclear aromatic hydrocarbon
PFSA = Petroleum Fuels Storage Area
RAO = Remedial/Removal Action Objective
RDX = Royal Demolition Explosive
RI = Remedial Investigation
ROD = Record of Decision
SD = Storm Drain
VPH =volatile petroleum hydrocarbon
USCG = U.S. Coast Guard

Table 2-1
No Further Action Sites
No 5-Year Review Required

No.	Site No.	Doc. Type	Document Date	NFA Based on PA (No Sampling)	NFA Based on SI (Sampling)	NFA Based on SI (Sampling & Risk Analysis)	NFA Based on RI	NFA Based on Remedial/ Removal Action	Comments
1	CS-1 USCG	ROD	Sep-95				X		
2	CS-2	DD	Oct-00			X			Excavation completed as part of DSRP.
3	CS-3/FS-23	DD	Apr-00			X			Other activities included the removal of structures as part of DSRP, UST removal, and Fuels Upgrade Program.
4	CS-3 USCG	ROD	Sep-98				X		1985 UST and contaminated soil removed from site. 340 cubic yards excavation completed as part of 1994 Fuel Systems Upgrade Program. Drainage structure abandoned in place during DSRP.
5	CS-5 USCG	DD	Aug-90	X					
6	CS-7	DD	Aug-90	X					
7	CS-7 USCG	DD	Aug-90	X					
8	CS-8	DD	Oct-00			X			UST removed and excavation completed as part of DSRP.
9	CS-9	DD	Jun-98				X		Structures and associated soil removed as part of DSRP.
10	CS-10 TWOU	DD	Feb-90		X				
11	CS-12	DD	Aug-90	X					
12	FS-2	ROD	Feb-02				X		520 tons of soil were removed and treated by a low thermal treatment system in 1996.
13	FS-14	DD	Apr-00			X			
14	FS-15	DD	Aug-90	X					
15	FS-16	DD	Aug-90	X					
16	FS-17/FS-19	ROD	Oct-99				X		Activities conducted included removals under the DSRP and Fuel Systems Upgrade Program.
17	FS-20	DD	Feb-90		X				
18	FS-21	DD	Oct-00			X			Current Product Tank removed.
19	FS-26	DD	Jul-97		X				UST Removal and no contamination below 15 feet below ground surface.
20	FS-27	DD	Dec-00			X			
21	LF-1 USCG	DD	Dec-95			X			
22	LF-2 USCG	DD	Aug-90	X					
23	LF-3	DD	Apr-97	X					
24	LF-3 USCG	DD	Aug-90	X					
25	LF-4	DD	Nov-00			X			
26	LF-5	DD	Aug-90	X					
27	LF-6	DD	Aug-90	X					

Key:
CS = Chemical Spill
DD = Decision Document
DSRP = Drainage Structure Removal Program
FS = Fuel Spill
LF = Landfill
NFA = No Further Action

PA = Prleiminary Assessment
ROD = Record of Decision
SI = Site Investigaton/Inspection
TWOU - Tank Washing Operable Unit
USCG = U.S. Coast Guard
UST = underground storage tank

Table 3-1
Installation Restoration Program Source Area Sites Requiring Five-Year Review

No.	Source Area Site	Document Type	Most Stringent Exposure Scenario	Soil PRE Performed?	Soil PRA Performed?	DSRP	Other Action	Is Risk Analysis Valid?	Protective/Issues
1	CS-1	DD	Worker (0-10 ft bgs)	Yes	No	Yes	Yes	TBD	Determine if site is allowable for unrestricted use.
2	CS-2 USCG	DD	Worker (0-2 ft bgs) (No evaluation for subsurface soil in SI)	Yes (see Table-3-3)	No	Yes	Yes	Surface Soil -yes. Subsurface Soil - TBD	Determine if site is allowable for unrestricted use.
3	CS-4	AM	Residential (0-15 ft bgs)	Yes	No	Yes	Yes- SARAP	Some screening levels were exceeded however removal action was implemented. RALs are more stringent than current PRGs and also take into consideration background.	Implementation of the removal action allows for unrestricted use.
4	CS-4 USCG/FS-1 (USCG)	AM	Worker (0-2 ft bgs) No evaluation for subsurface soil	Yes (see Table-3-3)	No	Yes	Yes-SARAP	TBD	Determine if site is allowable for unrestricted use.
5	CS-5	AM	Residential (surface) Worker (Subsurface)	Yes	Yes, Residential exceed $1x10^{-4.}$ Worker (subsurface soil < $1x10^{-5}$ & HI<1)	Yes	Yes-SARAP	TBD	Determine if site is allowable for unrestricted use.
6	CS-6/FS-22	DD	Residential (surface) Worker (Subsurface)	Worker (2-10 ft bgs)	Yes , Residential risk was $1.44x10^{-5}$ and HI<1	No	Yes- Sump	Residential PRA is valid. Worker PRE TBD.	Determine if site is allowable for unrestricted use.
7	CS-6 USCG	DD	Residential (0-2 ft.bgs) Worker (2-10 ft bgs))	Yes (see Table 3-2 & Table 3-3)	No	No	No	PAHs in surface soil exceeds residential Tier I HECs.	Determine if site is allowable for unrestricted use. Risk management decision to not address PAHs in surface soil.
8	CS-8 USCG		Residential (0-10 ft bgs)	2001 EPA Region IX PRGs were used for screening. Some current EPA PRGs exceed 2001 PRGs	No	No	Yes-SARAP	Some screening levels were exceeded however removal action was implemented. RALs are more stringent than current PRGs and also take into consideration background.	Implementation of the removal action allows for unrestricted use.
9	CS-10/FS-24	Remedial Action Report needs to completed.							
10	CS-11	AM	Residential (0-2 ft bgs) (No evaluation for subsurface soil)	Yes (see Table-3-2)	No	No	Yes-SARAP	TBD	Determine if site is allowable for unrestricted use.
11	CS-14	DD	Worker	PRE was performed but should be reevaluated.	No	Yes	Yes-Sump	Evaluate data - PRE may not be representative of site conditions.	Determine if site is allowable for unrestricted use.
12	CS-15	DD	Worker (0-10 ft.bgs)	Yes (modified) calculated risk is $1x10^{-6}$ and HI <1	Yes (modified) calculated risk is $1x10^{-6}$ and HI <1	Yes	No	Modified PRA is valid.	TBD-Cleanup
13	CS-16/CS-17	ROD	Residential (0-2 ft bgs) (No evaluation for subsurface soil)	N/A	Yes , Residential risk was $4.0x10^{-5}$ and HI<1	No	Yes-SARAP	SARAP Cleanup performed-impacts risk analysis	Determine if site is allowable for unrestricted use.
14	CS-18	Decision not determined and/or remedy not fully implemented							
15	CS-19	Decision not determined and/or remedy not fully implemented							
16	CS-22	AM	Residential (0-10 ft bgs)	2001 EPA Region IX PRGs were used for screening. Some current EPA PRGs exceed 2001 PRGs.	No	No	Yes-SARAP	Some screening levels were exceeded however removal action was implemented. RALs are more stringent than current PRG and also take into consideration background.	Implementation of the removal action allows for unrestricted use.

Table 3-1
Installation Restoration Program Source Area Sites Requiring Five-Year Review

No.	Source Area Site	Document Type	Most Stringent Exposure Scenario	Soil PRE Performed?	Soil PRA Performed?	DSRP	Other Action	Is Risk Analysis Valid?	Protective/Issues
17	CY-1/CY-3	DD	Compared to SARAP ecological risk-based RALS	No	No	No	No	SARAP RALs more stringent than current residential risk-based PRGs.	Worker PRA for CY-4 takes into consideration surface soil. Determine if site is allowable for unrestricted use.
18	CY-2	DD	Not Evaluated	N/A	N/A	No	N/A	N/A	Site conditions have changed due to construction of waste transfer station. AFCEE will reevaluate data used in the DD to determine if site characterization accurately represents site.
19	DDOU	AM	Not Evaluated	N/A	N/A	No	Yes-SARAP	TBD	Evaluate if soil is allowable for unrestricted use.
20	FS-1 (soil)	ROD	Worker	Yes	TBD, exposure assessment for soil performed but no risk or HI calculated	No	No	TBD	Evaluate if soil is allowable for unrestricted use.
21	FS-2 (USCG)	DD	Residential (0-2 ft bgs) Worker (0-10 ft bgs)	Yes-residential (see Table-3-2), worker-needs to be reevaluated	No	No	No	PAHs in surface soil exceeds worker Tier I .	Potential overestimation of Risk (surface soil data used in subsurface PRE). NFA for surface soil was based on biased sampling of asphalt-like substance.
22	FS-3	DD	Residential (0-2 ft bgs) Worker (0-10 ft bgs)	Yes-residential (see Table-2), worker-needs to be reevaluated	No	No	No	Metals in surface soil exceeds residential Tier I HECs.	Potential overestimation of Risk (surface soil data used in subsurface PRE). NFA for surface soil was based on comparison of COCs with background.
23	FS-4	AM	Worker (0-10 ft.bgs)	Yes (see Table-3-3)	No	No	Yes-FSUP	Yes.	Evaluate if soil is allowable for unrestricted use.
24	FS-7	AM	Residential (0-2 ft bgs) (No evaluation for subsurface soil)	Yes (see Table-3-2)	No	No	Yes-SARAP	PAHs exceeded Tier I residential HECs	SARAP cleanup was eco-risk based. Evaluate if soil is allowable for unrestricted use.
25	FS-9	ROD	Residential (0-2 ft bgs) Worker (0-10 ft bgs)	No	Yes, Residential is $2.2x10^{-5}$. Worker (subsurface soil < $1x10^{-5}$ & HI<1)	Yes	Yes-SARAP	Yes.	Evaluate if subsurface soil is allowable for unrestricted use.
26	FS-12	AM	Surface soil not evaluated. Subsurface soil evaluated based on worker.	No	Yes, Worker (subsurface soil < $1x10^{-5}$ & HI<1)	No	Yes	PRA is valid.	Remedy includes groundwater monitoring. Evaluate if soil is allowable for unrestricted use.
27	FS-13 Soil	DD	Residential (0-15 ft bgs)	2004 EPA Region IX PRGs were used. Comparison to current EPA PRGs not made because risk management was used for decision-making process.	No	No	No	Some screening levels were exceeded however detection frequency, comparison to background, etc., was evaluated for NFA -unrestricted use decision.	Allowable for unrestricted use
28	FS-18	AM	Residential (0-2 ft bgs) Worker (0-10 ft bgs)	Yes-residential (see Table-3-2), worker-needs to be reevaluated	No	Yes	No	NFA based on SARAP delineation sampling.	Remedial Design sampling supported NFA. Evaluate if subsurface soil is allowable for unrestricted use.
29	FS-25	DD	Worker (subsurface)	N/A	Yes, Residential (0-2 ft bgs 4x10-5 & HI<1) Worker (0-10 ft bgs < 1x10-5 & HI<1)	No	Yes	Yes	Determine if site is allowable for unrestricted use based on existing subsurface soil data.

Table 3-1
Installation Restoration Program Source Area Sites Requiring Five-Year Review

No.	Source Area Site	Document Type	Most Stringent Exposure Scenario	Soil PRE Performed?	Soil PRA Performed?	DSRP	Other Action	Is Risk Analysis Valid?	Protective/Issues
30	FTA-1	AM	Child Trespasser (0-2 ft bgs)			Yes	Yes		Determine if site is allowable for unrestricted use based on existing soil data.
31	FTA-2/LF-2	der Investigation- Potential Change in Remedy							
32	LF-1	ROD	Soil not evaluated- waste left in place	N/A	N/A	No	Yes	N/A	Landfill Cap and engineering controls in place. Groundwater monitored.
33	LF-7	DD	Soil not evaluated	N/A	N/A	No	No	No	Monitoring for radioactivity. Closure plan needs to be identified .
34	PFSA/FS-10/FS-11	der Investigation- Potential Change in Remedy							
35	SD-1	MassDEP has concerns regarding PAHs							
36	SD-2/FS-6/FS-8	ROD	Residential (0-2 ft bgs) Subsurface soil not evaluated	Yes	Yes, Residential (0-2 ft bgs 4x10-5 & HI<1) Worker (0-10 ft bgs < 1x10-5 & HI<1)	No	Yes-SARAP	Yes and SARAP Cleanup performed would likely lower calculated risk and HI.	Determine if site is allowable for unrestricted use based on existing subsurface soil data.
37	SD-3/FTA-3/CY-4	ROD	Trespasser (0-2 ft bgs) Worker (0-10 ft bgs)	Yes	Yes, Trespasser (0-2 ft bgs < 1x10-5 & HI<1) Worker (0-10 ft bgs < 1x10-5 & HI<1)	Yes	Yes-SARAP	SARAP Cleanup performed-impacts risk analysis	Worker PRA takes into consideration surface soil. Furthermore SARAP remedial action addressed eco-risk. Determine if site is allowable for unrestricted use.
38	SD-4	ROD	Residential (0-2 ft bgs) Subsurface soil not evaluated	No	Yes, Residential is $9.9x10^{-5}$ & HI<1) Primary contributors are arsenic and beryllium (found in background)	Yes	No	NFA based on SARAP ecological risk analysis.	Finalize RAR and ESD. Determine if subsurface soil is allowable for unrestricted use. Address TMB in groundwater.
39	SD-5/FS-5	Remedial Action Report needs to completed.							

Notes:
Sites highlighted in Red: Protectiveness and Technical Assessment to be determined because of issues listed.
Sites highlighted in Green: Site has been investigated and/or action performed in 2002-2007 and meets unrestricted use requirements .

Key:
AFCEE = Air Force Center for Engineering and the Environment
AM = Action Memorandum
CS = Chemical Spill
CY = Coal Yard
DD = Decision Document
DDOU = Drum Disposal Operable Unit
DSRP = Drainage Structure Removal Program
EPA = U.S. Environmental Protection Agency
FS = Fuel Spill
FSUP = Fuel Systems Upgrade Program
ft bgs = feet below ground surface
HI = hazard index
MassDEP = Massachusetts Department of Environmental Protection
NFA = No Further Action
PRA = preliminary risk assessment
PRE = preliminary risk evaluation
PRG = Preliminary Remediation Goals
RAL = removal action level
ROD = Record of Decision
SARAP = Source Area Remedial Action Program
SI = Site Investigation/Inspection
TBD = To Be Determined
USCG = U.S. Coast Guard

Table 3-2
Comparison of Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil & ORNL RAIS Residential Soil PRGs

		Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil			ORNL RAIS Residential Soil PRGs			Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Residential Soil PRG?
Analyte	CAS No.	Residential Tier I Outside Cancer	Residential Tier I Outside Non-Cancer	More Stringent Cancer vs. Non-Cancer	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs Risk = 1E-6	
Acenaphthene	83-32-9	7.38E-02	2.77E+03	7.38E-02	1.64E+04	-	1.64E+04	Yes
Acetone	67-64-1	-	1.91E+03	1.91E+03	6.27E+05	-	6.27E+05	Yes
Aldrin	309-00-2	7.72E-02	3.37E+00	7.72E-02	2.03E+01	9.07E-02	9.07E-02	Yes
Anthracene	120-12-7	7.38E-02	1.39E+04	7.38E-02	1.30E+05	-	1.30E+05	Yes
Antimony (metallic)	7440-36-0	-	2.20E+01	2.20E+01	2.43E+02	-	2.43E+02	Yes
Arsenic, Inorganic	7440-38-2	3.66E-01	1.65E+01	3.66E-01	1.70E+02	8.79E-01	8.79E-01	Yes
Barium	7440-39-3	-	3.84E+03	3.84E+03	1.29E+05	-	1.29E+05	Yes
Benz[a]anthracene	56-55-3	7.38E-02	-	7.38E-02	-	8.70E-01	8.70E-01	Yes
Benzene	71-43-2	9.87E-01	-	9.87E-01	3.24E+02	3.25E+00	3.25E+00	Yes
Benzo(g,h,i)perylene	191-24-2	7.38E-02	-	7.38E-02	-	-	-	Yes
Benzo[a]pyrene	50-32-8	7.38E-02	-	7.38E-02	-	8.72E-02	8.72E-02	Yes
Benzo[b]fluoranthene	205-99-2	7.38E-02	-	7.38E-02	-	8.73E-01	8.73E-01	Yes
Benzo[k]fluoranthene	207-08-9	7.38E-02	-	7.38E-02	-	8.73E+00	8.73E+00	Yes
Benzoic Acid	65-85-0	-	1.85E+05	1.85E+05	1.00E+06	-	1.00E+06	Yes
Beryllium and compounds	7440-41-7	1.49E-01	2.74E+02	1.49E-01	1.03E+03	2.83E-01	2.83E-01	Yes
Bis(2-ethylhexyl)phthalate	117-81-7	3.85E+01	9.24E+02	3.85E+01	1.21E+04	1.01E+02	1.01E+02	Yes
Butyl Benzyl Phthlate	85-68-7	-	9.24E+03	9.24E+03	1.37E+05	8.41E+02	8.41E+02	No
Cadmium (Diet)	7440-43-9	4.28E+03	2.74E+01	2.74E+01	5.22E+02	5.31E+03	5.22E+02	Yes
Carbon Tetrachloride	56-23-5	4.78E-01	1.33E+01	4.78E-01	4.81E+02	6.27E-01	6.27E-01	Yes
Chlordane (Gamma)	5103-74-2	1.01E+00	6.75E+00	1.01E+00	-	-	-	Yes
Chlorobenzene	108-90-7	-	3.81E+02	3.81E+02	1.02E+03	-	1.02E+03	Yes
Chloroform	67-66-3	4.26E-01	1.91E+02	4.26E-01	6.09E+03	7.63E-01	7.63E-01	Yes
Chloromethane	74-87-3	7.01E-01	7.62E+01	7.01E-01	3.45E+02	4.77E+00	4.77E+00	Yes
Chromium VI (particulates)	18540-29-9	6.57E+02	2.74E+02	2.74E+02	1.82E+03	7.96E+02	7.96E+02	Yes
Chrysene	218-01-9	7.38E-02	-	7.38E-02	-	8.72E+01	8.72E+01	Yes
Cyanide (CN-)	57-12-5	-	3.81E+02	3.81E+02	1.18E+04	-	1.18E+04	Yes
Dibenz[a,h]anthracene	53-70-3	7.38E-02	-	7.38E-02	-	8.73E-02	8.73E-02	Yes
Dibutyl Phthalate	84-74-2	-	4.62E+03	4.62E+03	7.02E+04	-	7.02E+04	Yes
Dichlorodiphenyl Dichloroethane, p, p' (DDD)	72-54-8	5.47E+00	-	5.47E+00	1.38E+03	6.71E+00	6.71E+00	Yes
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	3.86E+00	-	3.86E+00	-	4.74E+00	4.74E+00	Yes
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	3.86E+00	5.62E+01	3.86E+00	3.12E+02	4.25E+00	4.25E+00	Yes
Dichloroethane, 1,1-	75-34-3	-	2.70E+01	2.70E+01	3.59E+03	-	3.59E+03	Yes

Table 3-2
Comparison of Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil & ORNL RAIS Residential Soil PRGs

		Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil			ORNL RAIS Residential Soil PRGs			Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Residential Soil PRG?
Analyte	CAS No.	Residential Tier I Outside Cancer	Residential Tier I Outside Non-Cancer	More Stringent Cancer vs. Non-Cancer	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs Risk = 1E-6	
Dichloroethane, 1,2-	107-06-2	3.51E-01	5.72E+03	3.51E-01	1.40E+04	1.17E+00	1.17E+00	Yes
Dichloroethylene, 1,1-	75-35-4	6.94E-02	1.72E+02	6.94E-02	7.32E+02	1.64E-01	1.64E-01	Yes
Dichloroethylene, 1,2-trans-	156-60-5	-	3.81E+02	3.81E+02	3.79E+02	-	3.79E+02	No
Dichlorophenol, 2,4-	120-83-2	-	1.39E+02	1.39E+02	2.09E+03	-	2.09E+03	Yes
Dieldrin	60-57-1	8.20E-02	5.62E+00	8.20E-02	3.38E+01	9.52E-02	9.52E-02	Yes
Dinitrotoluene, 2,4-	121-14-2	7.93E-01	9.24E+01	7.93E-01	9.87E+02	1.69E+00	1.69E+00	Yes
Endrin	72-20-8	-	3.37E+01	3.37E+01	7.31E+01	-	7.31E+01	Yes
Ethylbenzene	100-41-4	-	1.06E+03	1.06E+03	1.49E+04	4.00E+01	4.00E+01	No
Ethylene Dibromide (Dibromoethane, 1,2-)	106-93-4	2.56E-03	-	2.56E-03	3.43E+02	1.31E-01	1.31E-01	Yes
Fluoranthene	206-44-0	7.38E-02	1.85E+03	7.38E-02	1.09E+04	-	1.09E+04	Yes
Fluorene	86-73-7	7.38E-02	1.85E+03	7.38E-02	1.43E+04	-	1.43E+04	Yes
Heptachlor	76-44-8	2.92E-01	5.62E-01	2.92E-01	3.46E+02	3.32E-01	3.32E-01	Yes
Heptachlor Epoxide	1024-57-3	1.44E-01	1.46E+00	1.44E-01	8.99E+00	1.65E-01	1.65E-01	Yes
Hexachlorobenzene	118-74-1	3.37E-01	3.70E+01	3.37E-01	5.41E+02	3.75E-01	3.75E-01	Yes
Hexachlorocyclohexane, Alpha- (BHC)	319-84-6	2.08E-01	-	2.08E-01	-	2.41E-01	2.41E-01	Yes
Hexachlorocyclohexane, Beta- (BHC)	319-85-7	7.29E-01	-	7.29E-01	-	8.80E-01	8.80E-01	Yes
Hexanone, 2	591-78-6	-	7.62E+02	7.62E+02	-	-	-	Yes
Indeno[1,2,3-cd]pyrene	193-39-5	7.38E-02	-	7.38E-02	-	8.73E-01	8.73E-01	Yes
Manganese (Water)	7439-96-5	-	2.74E+02	2.74E+02	2.66E+04	-	2.66E+04	Yes
Methoxychlor	72-43-5	-	5.62E+02	5.62E+02	3.38E+03	-	3.38E+03	Yes
Methyl Ethyl Ketone (2-Butanone)	78-93-3	-	8.80E+02	8.80E+02	-	-	-	Yes
Methylene Chloride (Dichloromethane)	75-09-2	7.89E+00	1.14E+03	7.89E+00	1.43E+04	3.08E+01	3.08E+01	Yes
Nickel Soluble Salts	7440-02-0	3.21E+04	1.10E+03	1.10E+03	1.44E+04	-	1.44E+04	Yes
Nitrobenzene	98-95-3	-	2.31E+01	2.31E+01	1.90E+02	-	1.90E+02	Yes
Phenanthrene	85-01-8	7.38E-02	-	7.38E-02	-	-	-	Yes
Phenol	108-95-2	-	2.77E+04	2.77E+04	2.10E+05	-	2.10E+05	Yes
Piperidine, 1- (Phenylcyclohexyl,1-)	77-10-1	4.49E+00	1.39E+03	4.49E+00	-	-	-	Yes
Polychlorinated Biphenyls	27323-18-8	1.70E-01	-	1.70E-01	-	4.88E-01	4.88E-01	Yes
Pyrene	129-00-0	7.38E-02	1.39E+03	7.38E-02	8.19E+03	-	8.19E+03	Yes
Selenium	7782-49-2	-	2.74E+02	2.74E+02	3.62E+03	-	3.62E+03	Yes
Silver	7440-22-4	-	2.74E+02	2.74E+02	3.57E+03	-	3.57E+03	Yes
Tetrachloroethane, 1,1,2,2-	79-34-5	5.50E-01	-	5.50E-01	4.14E+04	1.42E+00	1.42E+00	Yes

Table 3-2
Comparison of Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil & ORNL RAIS Residential Soil PRGs

		Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil			ORNL RAIS Residential Soil PRGs			
Analyte	**CAS No.**	**Residential Tier I Outside Cancer**	**Residential Tier I Outside Non-Cancer**	**More Stringent Cancer vs. Non-Cancer**	**Total Soil PRG HI = 1 (mg/kg)**	**Total Soil PRG Risk = 1E-6 (mg/kg)**	**More Stringent HI = 1 vs Risk = 1E-6**	**Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Residential Soil PRG?**
Tetrachloroethylene	127-18-4	-	1.91E+02	1.91E+02	2.54E+03	1.41E+00	1.41E+00	No
Thallium (Soluble Salts)	7440-28-0	-	4.39E+00	4.39E+00	-	-	-	Yes
Toluene	108-88-3	-	5.38E+02	5.38E+02	3.10E+04	-	3.10E+04	Yes
Trichloroethane, 1,1,2-	79-00-5	1.15E+00	7.62E+01	1.15E+00	2.78E+03	2.96E+00	2.96E+00	Yes
Trichloroethylene	79-01-6	4.66E+00	1.33E+02	4.66E+00	1.07E+02	1.36E-01	1.36E-01	No
Trichloropropane, 1,2,3-	96-18-4	-	1.14E+02	1.14E+02	4.17E+03	2.32E-01	2.32E-01	No
Vinyl Chloride	75-01-4	1.17E-01	-	1.17E-01	2.74E+02	4.74E-01	4.74E-01	Yes
Xylene, Mixture	1330-20-7	-	3.81E+04	3.81E+04	1.93E+03	-	1.93E+03	No
Zinc (Metallic)	7440-66-6	-	1.65E+04	1.65E+04	2.15E+05	-	2.15E+05	Yes

Key:
HEC = hazard equivalent concentration
HI = hazard index
mg/kg = milligrams per kilogram
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
SI = Site Investigation/Inspection

Table 3-3
Comparison of Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil,
2007 ORNL RAIS Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Excavation Soil PRGs

		Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil			2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs				
Analyte	CAS No.	Worker Tier I Cancer (mg/kg)	Worker Tier I Non-Cancer (mg/kg)	More Stringent Cancer vs. Non-Cancer (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Outdoor Industrial and Excavation Soil PRGs?
Acenaphthene	83-32-9	3.08E+00	1.93E+04	3.08E+00	1.81E+04	-	1.81E+04	1.00E+06	-	1.00E+06	1.81E+04	Yes
Acetone	67-64-1	-	1.00E+04	1.00E+04	9.47E+05	-	9.47E+05	1.00E+06	-	1.00E+06	9.47E+05	Yes
Aldrin	309-00-2	2.81E+00	2.04E+00	2.04E+00	3.01E+01	1.55E-01	1.55E-01	1.46E+02	1.47E+01	1.47E+01	1.55E-01	No
Anthracene	120-12-7	3.08E+00	9.64E+04	3.08E+00	1.60E+05	-	1.60E+05	1.00E+06	-	1.00E+06	1.60E+05	Yes
Antimony (metallic)	7440-36-0	-	1.70E+01	1.70E+01	3.42E+02	-	3.42E+02	6.73E+02	-	6.73E+02	3.42E+02	Yes
Arsenic, Inorganic	7440-38-2	1.70E+01	1.28E+01	1.28E+01	2.30E+02	1.43E+00	1.43E+00	9.52E+02	1.48E+02	1.48E+02	1.43E+00	No
Barium	7440-39-3	-	2.98E+03	2.98E+03	1.75E+05	-	1.75E+05	2.59E+05	-	2.59E+05	1.75E+05	Yes
Benz[a]anthracene	56-55-3	3.08E+00	-	3.08E+00	-	1.15E+00	1.15E+00	-	1.64E+02	1.64E+02	1.15E+00	No
Benzene	71-43-2	6.83E+01	-	6.83E+01	1.89E+02	2.26E+00	2.26E+00	1.93E+03	5.83E+02	5.83E+02	2.26E+00	No
Benzo(g,h,i)perylene	191-24-2	3.08E+00	-	3.08E+00	-	-	-	-	-	-	-	Yes
Benzo[a]pyrene	50-32-8	3.08E+00	-	3.08E+00	-	1.16E-01	1.16E-01	-	1.64E+01	1.64E+01	1.16E-01	No
Benzo[b]fluoranthene	205-99-2	3.08E+00	-	3.08E+00	-	1.16E+00	1.16E+00	-	1.64E+02	1.64E+02	1.16E+00	No
Benzo[k]fluoranthene	207-08-9	3.08E+00	-	3.08E+00	-	1.16E+01	1.16E+01	-	1.64E+03	1.64E+03	1.16E+01	Yes
Benzoic Acid	65-85-0	-	1.29E+05	1.29E+05	1.00E+06	-	1.00E+06	8.34E+03	-	8.34E+03	8.34E+03	No
Beryllium and compounds	7440-41-7	6.93E+00	2.13E+02	6.93E+00	1.33E+03	4.45E-01	4.45E-01	1.45E+04	4.85E+01	4.85E+01	4.45E-01	No
Bis(2-ethylhexyl)phthalate	117-81-7	1.61E+03	6.43E+02	6.43E+02	1.69E+04	1.69E+02	1.69E+02	6.69E+04	1.67E+04	1.67E+04	1.69E+02	No
Butyl Benzyl Phthlate	85-68-7	-	6.43E+04	6.43E+04	2.05E+05	1.51E+03	1.51E+03	1.00E+06	1.36E+05	1.36E+05	1.51E+03	No
Cadmium (Diet)	7440-43-9	3.59E+05	-	3.59E+05	6.84E+02	3.43E+03	6.84E+02	2.98E+03	9.65E+05	2.98E+03	6.84E+02	No
Carbon Tetrachloride	56-23-5	2.74E+01	7.01E+01	2.74E+01	7.22E+02	4.19E-01	4.19E-01	5.05E+02	1.13E+02	1.13E+02	4.19E-01	No
Chlordane (Gamma)	5566-34-7	3.67E+01	4.09E+00	4.09E+00	-	-	-	-	-	-	-	Yes
Chlorobenzene	108-90-7	-	4.57E+02	4.57E+02	5.78E+02	-	5.78E+02	5.27E+04	-	5.27E+04	5.78E+02	Yes
Chloroform	67-66-3	3.51E+01	1.00E+02	3.51E+01	8.54E+03	4.94E-01	4.94E-01	3.37E+04	1.39E+02	1.39E+02	4.94E-01	No
Chloromethane	74-87-3	5.51E+01	-	5.51E+01	1.86E+02	3.16E+00	3.16E+00	2.11E+05	8.63E+02	8.63E+02	3.16E+00	No
Chromium VI (particulates) (See Note 1)	18540-29-9	5.52E+04	8.52E+02	8.52E+02	2.53E+03	5.15E+02	5.15E+02	6.55E+04	1.45E+05	6.55E+04	5.15E+02	No
Chrysene	218-01-9	3.08E+00	-	3.08E+00	-	1.15E+02	1.15E+02	-	1.64E+04	1.64E+04	1.15E+02	Yes
Cyanide (CN-)	57-12-5	-	2.00E+02	2.00E+02	1.64E+04	-	1.64E+04	6.58E+04	-	6.58E+04	1.64E+04	Yes
Dibenz[a,h]anthracene	53-70-3	3.08E+00	-	3.08E+00	-	1.16E-01	1.16E-01	-	1.64E+01	1.64E+01	1.16E-01	No
Dibutyl Phthalate	84-74-2	-	3.21E+04	3.21E+04	1.07E+05	-	1.07E+05	1.00E+06	-	1.00E+06	1.07E+05	Yes
Dichlorobenzene, 1,4-	106-46-7	-	5.76E+03	5.76E+03	1.40E+04	1.23E+02	1.23E+02	4.91E+05	1.09E+04	1.09E+04	1.23E+02	No
Dichlorodiphenyl Dichloroethane, p, p' (DDD)	72-54-8	1.99E+02	-	1.99E+02	2.08E+03	1.21E+01	1.21E+01	7.42E+03	1.08E+03	1.08E+03	1.21E+01	No
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	1.40E+02	-	1.40E+02	-	8.55E+00	8.55E+00	-	7.64E+02	7.64E+02	8.55E+00	No
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	1.40E+02	3.41E+01	3.41E+01	4.43E+02	7.16E+00	7.16E+00	1.72E+03	7.02E+02	7.02E+02	7.16E+00	No
Dichloroethane, 1,1-	75-34-3	-	2.12E+03	2.12E+03	1.97E+03	-	1.97E+03	2.17E+05	-	2.17E+05	1.97E+03	No
Dichloroethane, 1,2-	107-06-2	2.38E+01	-	2.38E+01	2.13E+04	7.90E-01	7.90E-01	7.52E+04	2.11E+02	2.11E+02	7.90E-01	No
Dichloroethylene, 1,1-	75-35-4	4.44E+00	9.02E+01	4.44E+00	4.00E+02	1.10E-01	1.10E-01	3.99E+03	2.96E+01	2.96E+01	1.10E-01	No
Dichloroethylene, 1,2-cis-	156-59-2	-	1.00E+03	1.00E+03	1.07E+04	-	1.07E+04	3.76E+05	-	3.76E+05	1.07E+04	Yes
Dichloroethylene, 1,2-trans-	156-60-5	-	2.00E+03	2.00E+03	2.08E+02	-	2.08E+02	2.35E+03	-	2.35E+03	2.08E+02	No
Dichlorophenol, 2,4-	120-83-2	-	9.64E+01	9.64E+01	3.15E+03	-	3.15E+03	1.12E+04	-	1.12E+04	3.15E+03	Yes

Table 3-3
Comparison of Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil,
2007 ORNL RAIS Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Excavation Soil PRGs

		Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil			2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs				
Analyte	CAS No.	Worker Tier I Cancer (mg/kg)	Worker Tier I Non-Cancer (mg/kg)	More Stringent Cancer vs. Non-Cancer (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Outdoor Industrial and Excavation Soil PRGs?
Dieldrin	60-57-1	2.98E+00	3.41E+00	2.98E+00	5.02E+01	1.60E-01	1.60E-01	1.83E+02	1.55E+01	1.55E+01	1.60E-01	No
Dinitrotoluene, 2,4-	121-14-2	3.31E+01	-	3.31E+01	1.27E+03	2.61E+00	2.61E+00	5.69E+03	2.93E+02	2.93E+02	2.61E+00	No
Di-n-Octyl Phthalate	117-84-0	-	6.43E+02	6.43E+02	-	-	-	-	-	-	-	Yes
Endosulfan	115-29-7	-	1.36E+01	1.36E+01	6.02E+03	-	6.02E+03	2.19E+04	-	2.19E+04	6.02E+03	Yes
Endrin	72-20-8	-	2.04E+01	2.04E+01	7.92E+01	-	7.92E+01	4.65E+02	-	4.65E+02	7.92E+01	Yes
Ethylbenzene	100-41-4	-	2.50E+03	2.50E+03	9.26E+03	2.58E+01	2.58E+01	8.94E+04	7.26E+03	7.26E+03	2.58E+01	No
Ethylene Dibromide (Dibromoethane, 1,2-)	106-93-4	8.18E-02	-	8.18E-02	1.91E+02	9.48E-02	9.48E-02	4.82E+02	2.34E+01	2.34E+01	9.48E-02	Yes
Fluoranthene	206-44-0	3.08E+00	1.29E+04	3.08E+00	1.21E+04	-	1.21E+04	6.86E+05	-	6.86E+05	1.21E+04	Yes
Fluorene	86-73-7	3.08E+00	1.29E+04	3.08E+00	1.67E+04	-	1.67E+04	8.70E+05	-	8.70E+05	1.67E+04	Yes
Heptachlor	76-44-8	1.06E+01	3.41E+01	1.06E+01	5.20E+02	5.28E-01	5.28E-01	1.86E+03	5.39E+01	5.39E+01	5.28E-01	No
Heptachlor Epoxide	1024-57-3	5.24E+00	8.86E-01	8.86E-01	1.35E+01	2.65E-01	2.65E-01	4.83E+01	2.68E+01	2.68E+01	2.65E-01	No
Hexachlorobenzene	118-74-1	1.41E+01	2.57E+01	1.41E+01	8.03E+02	3.20E-01	3.20E-01	3.65E+02	6.51E+01	6.51E+01	3.20E-01	No
Hexachlorocyclohexane, Alpha- (BHC)	319-84-6	7.57E+00	-	7.57E+00	-	3.88E-01	3.88E-01	-	3.91E+01	3.91E+01	3.88E-01	No
Hexachlorocyclohexane, Beta- (BHC)	319-85-7	2.65E+01	-	2.65E+01	-	1.52E+00	1.52E+00	-	1.42E+02	1.42E+02	1.52E+00	No
Indeno[1,2,3-cd]pyrene	193-39-5	3.08E+00	-	3.08E+00	-	1.16E+00	1.16E+00	-	1.64E+02	1.64E+02	1.16E+00	No
Manganese (Water)	7439-96-5	-	4.21E+03	4.21E+03	3.19E+04	-	3.19E+04	1.77E+04	-	1.77E+04	1.77E+04	Yes
Mercury, Inorganic Salts	7487-94-7	-	1.28E+01	1.28E+01	3.11E+02	-	3.11E+02	1.11E+03	-	1.11E+03	3.11E+02	Yes
Methoxychlor	72-43-5	-	3.41E+02	3.41E+02	5.02E+03	-	5.02E+03	1.83E+04	-	1.83E+04	5.02E+03	Yes
Methyl Ethyl Ketone (2-Butanone)	78-93-3	-	2.29E+03	2.29E+03	-	-	-	-	-	-	-	Yes
Methylene Chloride (Dichloromethane)	75-09-2	4.59E+02	4.52E+02	4.52E+02	9.87E+03	2.19E+01	2.19E+01	8.30E+04	5.50E+03	5.50E+03	2.19E+01	No
Naphthalene	91-20-3	-	1.29E+03	1.29E+03	2.61E+02	-	2.61E+02	2.85E+03	-	2.85E+03	2.61E+02	No
Nickel Soluble Salts	7440-02-0	2.70E+06	8.52E+02	8.52E+02	2.22E+04	-	2.22E+04	7.66E+04	-	7.66E+04	2.22E+04	Yes
Nitrobenzene	98-95-3	-	1.08E+02	1.08E+02	1.58E+02	-	1.58E+02	1.08E+04	-	1.08E+04	1.58E+02	Yes
Phenanthrene	85-01-8	3.08E+00	-	3.08E+00	-	-	-	-	-	-	-	Yes
Phenol	108-95-2	-	1.93E+04	1.93E+04	3.17E+05	-	3.17E+05	1.00E+06	-	1.00E+06	3.17E+05	Yes
Piperidine, 1- (Phenylcyclohexyl,1-)	77-10-1	1.87E+02	9.64E+02	1.87E+02	-	-	-	-	-	-	-	Yes
Polychlorinated Biphenyls	27323-18-8	6.19E+00	-	6.19E+00	-	6.67E-01	6.67E-01	-	8.61E+01	8.61E+01	6.67E-01	No
Pyrene	129-00-0	3.08E+00	9.64E+03	3.08E+00	9.04E+03	-	9.04E+03	5.14E+05	-	5.14E+05	9.04E+03	Yes
Selenium	7782-49-2	-	2.13E+02	2.13E+02	5.59E+03	-	5.59E+03	1.92E+04	-	1.92E+04	5.59E+03	Yes
Silver	7440-22-4	-	2.13E+02	2.13E+02	5.48E+03	-	5.48E+03	1.90E+04	-	1.90E+04	5.48E+03	Yes
Tetrachloroethane, 1,1,2,2-	79-34-5	2.53E+01	-	2.53E+01	6.23E+04	1.03E+00	1.03E+00	2.23E+05	2.52E+02	2.52E+02	1.03E+00	No
Tetrachloroethylene	127-18-4	-	1.00E+03	1.00E+03	1.79E+03	1.30E+00	1.30E+00	2.27E+04	2.41E+02	2.41E+02	1.30E+00	No
Thallium (Soluble Salts)	7440-28-0	-	3.41E+01	3.41E+01	-	-	-	-	-	-	-	Yes
Toluene	108-88-3	-	3.59E+03	3.59E+03	2.60E+04	-	2.60E+04	7.74E+04	-	7.74E+04	2.60E+04	Yes
Trichloroethane, 1,1,1-	71-55-6	-	4.99E+03	4.99E+03	5.78E+03	-	5.78E+03	3.53E+05	-	3.53E+05	5.78E+03	Yes
Trichloroethane, 1,1,2-	79-00-5	6.47E+01	4.01E+02	6.47E+01	4.20E+03	2.05E+00	2.05E+00	1.49E+05	5.30E+02	5.30E+02	2.05E+00	No
Trichloroethylene	79-01-6	2.83E+02	-	2.83E+02	9.15E+01	8.99E-02	8.99E-02	6.14E+02	2.46E+01	2.46E+01	8.99E-02	No
Trichloropropane, 1,2,3-	96-18-4	-	6.01E+02	6.01E+02	6.29E+03	4.20E-01	4.20E-01	2.24E+05	3.73E+01	3.73E+01	4.20E-01	No

Table 3-3
Comparison of Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil,
2007 ORNL RAIS Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Excavation Soil PRGs

		Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil			2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs				
Analyte	CAS No.	Worker Tier I Cancer (mg/kg)	Worker Tier I Non-Cancer (mg/kg)	More Stringent Cancer vs. Non-Cancer (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Outdoor Industrial and Excavation Soil PRGs?
Vanadium, Metallic	7440-62-2	-	2.98E+02	2.98E+02	4.79E+03	-	4.79E+03	2.08E+04	-	2.08E+04	4.79E+03	Yes
Vinyl Chloride	75-01-4	3.69E+00	-	3.69E+00	1.61E+02	4.25E-01	4.25E-01	1.63E+03	8.14E+01	8.14E+01	4.25E-01	No
Xylene, Mixture	1330-20-7	-	4.01E+04	4.01E+04	1.05E+03	-	1.05E+03	1.17E+04	-	1.17E+04	1.05E+03	No
Zinc (Metallic)	7440-66-6	-	8.52E+03	8.52E+03	3.30E+05	-	3.30E+05	1.00E+06	-	1.00E+06	3.30E+05	Yes

Note:
(1) The reported concentration for the Priority 2 and 3 HECs for Chromium is based on Total Chromium not Chromium IV.

Key:
HEC = hazard equivalent concentration
HI = hazard index
mg/kg = milligrams per kilogram
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
SI = Site Investigation/Inspection

Table 3-4
CS-4, CS-8 USCG, and CS-22 Contaminants of Concern
Comparison of 2007 ORNL RAIS Residential Soil PRGs
to Removal Action Levels

Analyte	CAS No.	ORNL RAIS Residential Soil PRGs (May 2007)			Removal Action Level (mg/kg)	Is the RAL More Stringent than the ORNL RAIS Residential Soil PRG?
		Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)		
CS-4 COCs						
Aroclor 1260	11096-82-5	-	5.10E-01	5.10E-01	1.00E+00	No
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	-	4.74E+00	4.74E+00	2.27E-01	Yes
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	3.12E+02	4.25E+00	4.25E+00	2.50E-01	Yes
Dieldrin	60-57-1	3.38E+01	9.52E-02	9.52E-02	3.50E-02	Yes
Lead and Compounds	7439-92-1	-	-	-	3.00E+02	Yes
		-	-	-	9.90E+01	Yes
Zinc (Metallic)	7440-66-6	2.15E+05	-	2.15E+05	6.80E+01	Yes
CS-8 USCG COCs						
Cadmium (Diet)	7440-43-9	5.22E+02	5.31E+03	5.22E+02	1.8E+00	Yes
Manganese (Water)	7439-96-5	2.66E+04	-	2.66E+04	2.7E+02	Yes
Aroclor 1254	11097-69-1	9.01E+00	5.00E-01	5.00E-01	1.0E+00	No
CS-22 COCs						
Aluminum	7429-90-5	6.79E+05	-	6.79E+05	8.9E+03	Yes
Arsenic, Inorganic	7440-38-2	1.7E+02	8.8E-01	8.8E-01	7.1E+00	No
Benz[a]anthracene	56-55-3	-	8.7E-01	8.7E-01	7.0E-01	Yes
Benzo[a]pyrene	50-32-8	-	8.7E-02	8.7E-02	6.3E-01	No
Benzo[b]fluoranthene	205-99-2	-	8.7E-01	8.7E-01	7.0E-01	Yes
Chromium VI (particulates)	18540-29-9	1.82E+03	8.0E+02	8.0E+02	1.9E+01	Yes
Dibenz[a,h]anthracene	53-70-3	-	8.7E-02	8.7E-02	7.0E-01	No
Indeno[1,2,3-cd]pyrene	193-39-5	-	8.7E-01	8.7E-01	7.0E-01	Yes
Lead and Compounds	7439-92-1	-	-	-	9.9E+01	Yes
Selenium	7782-49-2	3.62E+03	-	3.62E+03	1.0E+00	Yes

Key:
COC = contaminant of concern
CS = Chemical Spill
HI = hazard index
mg/kg = milligrams per kilogram
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
RAL = removal action level
USCG = U.S. Coast Guard

Table 3-5
Comparison of DSRP Soil Target Cleanup Levels (1999) & 2007 ORNL RAIS Risk-Based Residential Soil PRGs

Analyte	CAS No.	DSRP STCLs Outside Flightline (Residential) (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Residential Soil PRGs			Is the ORNL RAIS Residential Soil PRG More Stringent Than The DSRP STCL?	Is the ORNL RAIS Residential Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6		
Acenaphthene	83-32-9	3.29E+03		1.64E+04	-	1.64E+04	No	
Acetone	67-64-1	5.49E+03		6.27E+05	-	6.27E+05	No	
Aldrin	309-00-2	1.26E-01		2.03E+01	9.07E-02	9.07E-02	Yes	
Aluminum	7429-90-5	5.49E+04	8.93E+03	6.79E+05	-	6.79E+05	No	No
Anthracene	120-12-7	1.00E+04		1.30E+05	-	1.30E+05	No	
Antimony (metallic)	7440-36-0	2.20E+01	1.75E+01	2.43E+02	-	2.43E+02	No	No
Aroclor 1016	12674-11-2	1.58E-01		3.15E+01	4.85E-01	4.85E-01	No	
Aroclor 1221	11104-28-2	1.58E-01		-	5.25E-01	5.25E-01	No	
Aroclor 1232	11141-16-5	1.58E-01		-	5.25E-01	5.25E-01	No	
Aroclor 1242	53469-21-9	1.58E-01		-	4.85E-01	4.85E-01	No	
Aroclor 1248	12672-29-6	1.58E-01		-	5.25E-01	5.25E-01	No	
Aroclor 1254	11097-69-1	1.58E-01		9.01E+00	5.00E-01	5.00E-01	No	
Aroclor 1260	11096-82-5	1.58E-01		-	5.10E-01	5.10E-01	No	
Arsenic, Inorganic	7440-38-2	3.60E+00	3.60E+00	1.70E+02	8.79E-01	8.79E-01	Yes	Yes
Barium	7440-39-3	3.80E+03	1.40E+01	1.29E+05	-	1.29E+05	No	No
Benz[a]anthracene	56-55-3	5.00E+00		-	8.70E-01	8.70E-01	Yes	
Benzene	71-43-2	1.00E-02		3.24E+02	3.25E+00	3.25E+00	No	
Benzo(g,h,i)perylene	191-24-2	5.00E+00		-	-	-	No	
Benzo[a]pyrene	50-32-8	5.00E+00		-	8.72E-02	8.72E-02	Yes	
Benzo[b]fluoranthene	205-99-2	5.00E+00		-	8.73E-01	8.73E-01	Yes	
Benzo[k]fluoranthene	207-08-9	5.00E+00		-	8.73E+00	8.73E+00	No	
Beryllium and compounds	7440-41-7	1.00E+00	6.50E-01	1.03E+03	2.83E-01	2.83E-01	Yes	Yes
Bis(2-chloroethyl)ether	111-44-4	7.00E-01		-	4.76E-01	4.76E-01	Yes	
Bis(2-ethylhexyl)phthalate	117-81-7	4.57E+01		1.21E+04	1.01E+02	1.01E+02	No	
Bromodichloromethane	75-27-4	1.00E-01		1.40E+04	2.64E+01	2.64E+01	No	
Bromoform	75-25-2	1.00E-01		1.37E+04	6.97E+01	6.97E+01	No	
Bromomethane	74-83-9	1.00E+01		2.79E+01	-	2.79E+01	No	
Butyl Benzyl Phthlate	85-68-7	1.10E+04		1.37E+05	8.41E+02	8.41E+02	Yes	
Cadmium (Diet)	7440-43-9	2.64E+01	1.50E+00	5.22E+02	5.31E+03	5.22E+02	No	No
Carbazole	86-74-8	3.20E+01		-	8.06E+01	8.06E+01	No	
Carbon Tetrachloride	56-23-5	1.00E-02		4.81E+02	6.27E-01	6.27E-01	No	
Chlordane	57-74-9	1.00E+00		2.63E+02	3.61E+00	3.61E+00	No	
Chlordane (Gamma)	5566-34-7	1.64E+00		NA	NA	NA	No	
Chloroaniline, p-	106-47-8	1.00E+00		2.70E+03	2.92E+01	2.92E+01	No	

Table 3-5
Comparison of DSRP Soil Target Cleanup Levels (1999) & 2007 ORNL RAIS Risk-Based Residential Soil PRGs

Analyte	CAS No.	DSRP STCLs Outside Flightline (Residential) (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Residential Soil PRGs Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6	Is the ORNL RAIS Residential Soil PRG More Stringent Than The DSRP STCL?	Is the ORNL RAIS Residential Soil PRG More Stringent Than MMR Background (Inorganics Only)?
Chlorobenzene	108-90-7	1.00E-01		1.02E+03	-	1.02E+03	No	
Chloroform	67-66-3	1.00E-01		6.09E+03	7.63E-01	7.63E-01	No	
Chloromethane	74-87-3	7.20E-01		3.45E+02	4.77E+00	4.77E+00	No	
Chlorophenol, 2-	95-57-8	2.74E+02		3.38E+03	-	3.38E+03	No	
Chromium VI (particulates) (See Note 1)	18540-29-9	2.74E+02	1.90E+01	1.82E+03	7.96E+02	7.96E+02	No	No
Chrysene	218-01-9	8.77E+01		-	8.72E+01	8.72E+01	Yes	
Cresol, o- (Methylphenol, 2)	95-48-7	3.30E-01		3.38E+04	-	3.38E+04	No	
Cresol, p- (Methylphenol, 4)	106-44-5	3.30E-01		3.44E+03	-	3.44E+03	No	
Cyanide (CN-)	57-12-5	1.10E+03	7.00E-01	1.18E+04	-	1.18E+04	No	No
Dibenz[a,h]anthracene	53-70-3	5.00E+00		-	8.73E-02	8.73E-02	Yes	
Dibenzofuran	132-64-9	2.20E+02		1.39E+03	-	1.39E+03	No	
Dibromochloromethane	124-48-1	9.00E-02		1.37E+04	1.90E+01	1.90E+01	No	
Dibutyl Phthalate	84-74-2	5.49E+03		7.02E+04	-	7.02E+04	No	
Dichlorobenzene, 1,2-	95-50-1	1.00E+02		6.56E+03	-	6.56E+03	No	
Dichlorobenzene, 1,3-	541-73-1	1.00E+02		-	-	-	No	
Dichlorobenzene, 1,4-	106-46-7	2.67E+01		2.59E+04	6.80E+01	6.80E+01	No	
Dichlorobenzidine, 3,3'-	91-94-1	1.00E+00		-	3.51E+00	3.51E+00	No	
Dichlorodiphenyl Dichloroethane, p, p' (DDD)	72-54-8	8.89E+00		1.38E+03	6.71E+00	6.71E+00	Yes	
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	6.28E+00		-	4.74E+00	4.74E+00	Yes	
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	6.28E+00		3.12E+02	4.25E+00	4.25E+00	Yes	
Dichloroethane, 1,1-	75-34-3	2.59E+02		3.59E+03	-	3.59E+03	No	
Dichloroethane, 1,2-	107-06-2	1.00E-02		1.40E+04	1.17E+00	1.17E+00	No	
Dichloroethylene, 1,1-	75-35-4	1.00E-02		7.32E+02	1.64E-01	1.64E-01	No	
Dichloroethylene, 1,2-cis-	156-59-2	7.00E-02		7.02E+03	-	7.02E+03	No	
Dichloroethylene, 1,2-trans-	156-60-5	1.10E+03		3.79E+02	-	3.79E+02	Yes	
Dichlorophenol, 2,4-	120-83-2	3.30E-01		2.09E+03	-	2.09E+03	No	
Dichloropropane, 1,2-	78-87-5	1.00E-02		4.96E+01	2.38E+01	2.38E+01	No	
Dichloropropene, 1,3- (cis + trans)	542-75-6	1.00E-02		1.39E+04	-	1.39E+04	No	
Dieldrin	60-57-1	1.33E-01		3.38E+01	9.52E-02	9.52E-02	Yes	
Diethyl Phthalate	84-66-2	1.00E+04		5.59E+05	-	5.59E+05	No	
Dimethyl Phthalate	131-11-3	3.00E+01		1.00E+06	-	1.00E+06	No	
Dimethylphenol, 2,4-	105-67-9	1.10E+03		1.35E+04	-	1.35E+04	No	
Dinitrophenol, 2,4-	51-28-5	8.00E-01		1.40E+03	-	1.40E+03	No	
Dinitrotoluene, 2,4-	121-14-2	3.30E-01		9.87E+02	1.69E+00	1.69E+00	No	

Table 3-5
Comparison of DSRP Soil Target Cleanup Levels (1999) & 2007 ORNL RAIS Risk-Based Residential Soil PRGs

Analyte	CAS No.	DSRP STCLs Outside Flightline (Residential) (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Residential Soil PRGs			Is the ORNL RAIS Residential Soil PRG More Stringent Than The DSRP STCL?	Is the ORNL RAIS Residential Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6		
Di-n-Octyl Phthalate	117-84-0	1.10E+03		NA	NA	NA	No	
Endosulfan	115-29-7	6.00E+01		4.06E+03	-	4.06E+03	No	
Endosulfan II	891-86-1	2.00E-01		NA	NA	NA	No	
Endrin	72-20-8	5.49E+01		7.31E+01	-	7.31E+01	No	
Ethylbenzene	100-41-4	7.00E-01		1.49E+04	4.00E+01	4.00E+01	No	
Fluoranthene	206-44-0	2.20E+03		1.09E+04	-	1.09E+04	No	
Fluorene	86-73-7	2.20E+03		1.43E+04	-	1.43E+04	No	
Heptachlor	76-44-8	1.70E-03		3.46E+02	3.32E-01	3.32E-01	No	
Heptachlor Epoxide	1024-57-3	2.35E-01		8.99E+00	1.65E-01	1.65E-01	Yes	
Hexachlorobenzene	118-74-1	4.00E-01		5.41E+02	3.75E-01	3.75E-01	Yes	
Hexachlorobutadiene	87-68-3	3.00E+00		1.35E+02	2.44E+00	2.44E+00	Yes	
Hexachlorocyclohexane, Alpha- (BHC)	319-84-6	3.39E-01		-	2.41E-01	2.41E-01	Yes	
Hexachlorocyclohexane, Beta- (BHC)	319-85-7	1.19E+00		-	8.80E-01	8.80E-01	Yes	
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	1.64E+00		1.88E+02	1.13E+00	1.13E+00	Yes	
Hexachloroethane	67-72-1	6.00E+00		6.76E+02	3.81E+01	3.81E+01	No	
Hexanone, 2	591-78-6	2.20E+03		-	-	-	No	
Indeno[1,2,3-cd]pyrene	193-39-5	5.00E+00		-	8.73E-01	8.73E-01	Yes	
Isophorone	78-59-1	6.74E+02		1.35E+05	1.66E+03	1.66E+03	No	
Lead and Compounds	7439-92-1	3.00E+02	9.90E+01	-	-	-	No	No
Manganese (Water)	7439-96-5	2.74E+02	1.08E+02	2.66E+04	-	2.66E+04	No	No
Mercury, Inorganic Salts	7487-94-7	1.65E+01	6.00E-02	2.07E+02	-	2.07E+02	No	No
Methoxychlor	72-43-5	9.15E+02		3.38E+03	-	3.38E+03	No	
Methyl Ethyl Ketone (2-Butanone)	78-93-3	9.26E+02		NA	NA	NA	No	
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	108-10-1	5.00E-01		NA	NA	NA	No	
Methylene Chloride (Dichloromethane)	75-09-2	1.00E-02		1.43E+04	3.08E+01	3.08E+01	No	
Methylnaphthalene, 2-	91-57-6	7.00E-01		2.78E+03	-	2.78E+03	No	
Naphthalene	91-20-3	2.20E+03		4.71E+02	-	4.71E+02	Yes	
Nickel Soluble Salts	7440-02-0	1.10E+03	5.20E+00	1.44E+04	-	1.44E+04	No	No
Nitroaniline, 2	88-74-4	8.00E-01		9.35E+01	-	9.35E+01	No	
Nitroaniline, 3	99-09-2	8.00E-01		2.09E+02	7.73E+01	7.73E+01	No	
Nitrobenzene	98-95-3	2.74E+01		1.90E+02	-	1.90E+02	No	
Pentachlorophenol	87-86-5	5.34E+00		1.10E+04	7.11E+00	7.11E+00	No	
Phenanthrene	85-01-8	2.20E+03		-	-	-	No	
Phenol	108-95-2	1.00E+04		2.10E+05	-	2.10E+05	No	

Table 3-5
Comparison of DSRP Soil Target Cleanup Levels (1999) & 2007 ORNL RAIS Risk-Based Residential Soil PRGs

Analyte	CAS No.	DSRP STCLs Outside Flightline (Residential) (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Residential Soil PRGs			Is the ORNL RAIS Residential Soil PRG More Stringent Than The DSRP STCL?	Is the ORNL RAIS Residential Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6		
Pyrene	129-00-0	1.65E+03		8.19E+03	-	8.19E+03	No	
Selenium	7782-49-2	2.74E+02	3.30E-01	3.62E+03	-	3.62E+03	No	No
Silver	7440-22-4	2.74E+02	2.40E+00	3.57E+03	-	3.57E+03	No	No
Styrene	100-42-5	1.00E-01		2.64E+04	-	2.64E+04	No	
Tetrachloroethane, 1,1,2,2-	79-34-5	8.13E-01		4.14E+04	1.42E+00	1.42E+00	No	
Tetrachloroethylene	127-18-4	1.00E-02		2.54E+03	1.41E+00	1.41E+00	No	
Thallium (Soluble Salts)	7440-28-0	4.39E+00	2.50E-01	-	-	-	No	No
Toluene	108-88-3	1.00E+00		3.10E+04	-	3.10E+04	No	
Toxaphene	8001-35-2	1.70E-01		-	1.42E+00	1.42E+00	No	
Trichlorobenzene, 1,2,4-	120-82-1	4.89E+02		3.12E+02	-	3.12E+02	Yes	
Trichloroethane, 1,1,1-	71-55-6	2.00E-01		1.02E+04	-	1.02E+04	No	
Trichloroethane, 1,1,2-	79-00-5	1.00E-02		2.78E+03	2.96E+00	2.96E+00	No	
Trichloroethylene	79-01-6	1.00E-02		1.07E+02	1.36E-01	1.36E-01	No	
Trichlorophenol, 2,4,5-	95-95-4	3.00E+00		6.76E+04	-	6.76E+04	No	
Trichlorophenol, 2,4,6-	88-06-2	3.00E+00		-	1.32E+02	1.32E+02	No	
Vanadium, Metallic	7440-62-2	3.84E+02	1.52E+01	3.65E+03	-	3.65E+03	No	No
Vinyl Chloride	75-01-4	1.00E-02		2.74E+02	4.74E-01	4.74E-01	No	
Xylene, Mixture	1330-20-7	1.00E+01		1.93E+03	-	1.93E+03	No	
Zinc (Metallic)	7440-66-6	1.00E+04	1.60E+01	2.15E+05	-	2.15E+05	No	No

Note:

(1) The reported concentration for the DSRP STCL for Chromium is based on Total Chromium not Chromium IV.

Key:

DSRP = Drainage Structure Removal Program
HI = hazard index
mg/kg = milligrams per kilogram
MMR = Massachusetts Military Reservation
NA = not applicable
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
RAL = removal action level
STCL = soil target cleanup level

Table 3-6
Comparision of DSRP Soil Target Cleanup Levels (1999), 2007 ORNL RAIS Risk Based Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Risk Based Excavation Soil PRGs

				2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs					
Analyte	CAS No.	DSRP STCLs Inside Flightline (Human Only) 0-15 ft bgs (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than the DSRP STCL?	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than MMR Background (Inorganics Only)?
Acenaphthene	83-32-9	1.00E+04		1.81E+04	-	1.81E+04	1.00E+06	-	1.00E+06	1.81E+04	No	
Acetone	67-64-1	1.00E+04		9.47E+05	-	9.47E+05	1.00E+06	-	1.00E+06	9.47E+05	No	
Aldrin	309-00-2	1.00E+00		3.01E+01	1.55E-01	1.55E-01	1.46E+02	1.47E+01	1.47E+01	1.55E-01	Yes	
Aluminum	7429-90-5	5.82E+04	8.93E+03	9.71E+05	-	9.71E+05	1.00E+06	-	1.00E+06	9.71E+05	No	No
Anthracene	120-12-7	1.00E+04		1.60E+05	-	1.60E+05	1.00E+06	-	1.00E+06	1.60E+05	No	
Antimony (metallic)	7440-36-0	2.33E+01	1.75E+01	3.42E+02	-	3.42E+02	6.73E+02	-	6.73E+02	3.42E+02	No	No
Aroclor 1016	12674-11-2	3.83E+00		3.92E+01	6.57E-01	6.57E-01	1.85E+02	8.54E+01	8.54E+01	6.57E-01	Yes	
Aroclor 1221	11104-28-2	3.83E+00		-	7.84E-01	7.84E-01	-	9.24E+01	9.24E+01	7.84E-01	Yes	
Aroclor 1232	11141-16-5	3.83E+00		-	7.84E-01	7.84E-01	-	9.24E+01	9.24E+01	7.84E-01	Yes	
Aroclor 1242	53469-21-9	3.83E+00		-	6.57E-01	6.57E-01	-	8.54E+01	8.54E+01	6.57E-01	Yes	
Aroclor 1248	12672-29-6	3.83E+00		-	7.84E-01	7.84E-01	-	9.24E+01	9.24E+01	7.84E-01	Yes	
Aroclor 1254	11097-69-1	3.83E+00		1.12E+01	7.03E-01	7.03E-01	1.32E+02	8.81E+01	8.81E+01	7.03E-01	Yes	
Aroclor 1260	11096-82-5	3.83E+00		-	7.32E-01	7.32E-01	-	8.97E+01	8.97E+01	7.32E-01	Yes	
Arsenic, Inorganic	7440-38-2	1.16E+01	3.60E+00	2.30E+02	1.43E+00	1.43E+00	9.52E+02	1.48E+02	1.48E+02	1.43E+00	Yes	Yes
Barium	7440-39-3	4.07E+03	1.40E+01	1.75E+05	-	1.75E+05	2.59E+05	-	2.59E+05	1.75E+05	No	No
Benz[a]anthracene	56-55-3	2.79E+01		-	1.15E+00	1.15E+00	-	1.64E+02	1.64E+02	1.15E+00	Yes	
Benzene	71-43-2	1.00E-02		1.89E+02	2.26E+00	2.26E+00	1.93E+03	5.83E+02	5.83E+02	2.26E+00	No	
Benzo(g,h,i)perylene	191-24-2	2.33E+03		-	-	-	-	-	-	-	No	
Benzo[a]pyrene	50-32-8	2.79E+00		-	1.16E-01	1.16E-01	-	1.64E+01	1.64E+01	1.16E-01	Yes	
Benzo[b]fluoranthene	205-99-2	2.79E+01		-	1.16E+00	1.16E+00	-	1.64E+02	1.64E+02	1.16E+00	Yes	
Benzo[k]fluoranthene	207-08-9	2.79E+02		-	1.16E+01	1.16E+01	-	1.64E+03	1.64E+03	1.16E+01	Yes	
Beryllium and compounds	7440-41-7	4.73E+00	6.50E-01	1.33E+03	4.45E-01	4.45E-01	1.45E+04	4.85E+01	4.85E+01	4.45E-01	Yes	Yes
Bis(2-chloroethyl)ether	111-44-4	7.00E-01		-	3.90E-01	3.90E-01	-	8.32E+01	8.32E+01	3.90E-01	Yes	
Bis(2-ethylhexyl)phthalate	117-81-7	1.16E+03		1.69E+04	1.69E+02	1.69E+02	6.69E+04	1.67E+04	1.67E+04	1.69E+02	Yes	
Bromodichloromethane	75-27-4	1.00E-01		2.13E+04	4.80E+01	4.80E+01	7.51E+04	4.24E+03	4.24E+03	4.80E+01	No	
Bromoform	75-25-2	1.00E-01		2.05E+04	5.78E+01	5.78E+01	1.11E+05	1.22E+04	1.22E+04	5.78E+01	No	
Bromomethane	74-83-9	1.00E+01		1.53E+01	-	1.53E+01	2.94E+03	-	2.94E+03	1.53E+01	No	
Butyl Benzyl Phthlate	85-68-7	1.16E+05		2.05E+05	1.51E+03	1.51E+03	1.00E+06	1.36E+05	1.36E+05	1.51E+03	Yes	
Cadmium (Diet)	7440-43-9	2.73E+01	1.50E+00	6.84E+02	3.43E+03	6.84E+02	2.98E+03	9.65E+05	2.98E+03	6.84E+02	No	No
Carbazole	86-74-8	1.02E+03		-	1.45E+02	1.45E+02	-	1.30E+04	1.30E+04	1.45E+02	Yes	
Carbon Tetrachloride	56-23-5	1.00E-02		7.22E+02	4.19E-01	4.19E-01	5.05E+02	1.13E+02	1.13E+02	4.19E-01	No	
Chlordane	57-74-9	5.00E+00		3.29E+02	5.65E+00	5.65E+00	1.86E+02	6.12E+02	1.86E+02	5.65E+00	No	
Chlordane (Gamma)	5566-34-7	1.16E+01		-	-	-	-	-	-	-	No	
Chloroaniline, p-	106-47-8	1.00E+00		4.01E+03	5.20E+01	5.20E+01	1.46E+04	4.73E+03	4.73E+03	5.20E+01	No	
Chlorobenzene	108-90-7	1.00E-01		5.78E+02	-	5.78E+02	5.27E+04	-	5.27E+04	5.78E+02	No	
Chloroform	67-66-3	1.00E-01		8.54E+03	4.94E-01	4.94E-01	3.37E+04	1.39E+02	1.39E+02	4.94E-01	No	
Chloromethane	74-87-3	4.09E+01		1.86E+02	3.16E+00	3.16E+00	2.11E+05	8.63E+02	8.63E+02	3.16E+00	Yes	
Chlorophenol, 2-	95-57-8	2.91E+03		5.02E+03	-	5.02E+03	1.83E+05	-	1.83E+05	5.02E+03	No	

Table 3-6
Comparision of DSRP Soil Target Cleanup Levels (1999), 2007 ORNL RAIS Risk Based Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Risk Based Excavation Soil PRGs

Analyte	CAS No.	DSRP STCLs Inside Flightline (Human Only) 0-15 ft bgs (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs			More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than the DSRP STCL?	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)			
Chromium VI (particulates)	18540-29-9	1.16E+03	1.90E+01	2.53E+03	5.15E+02	5.15E+02	6.55E+04	1.45E+05	6.55E+04	5.15E+02	Yes	No
Chrysene	218-01-9	4.00E+02		-	1.15E+02	1.15E+02	-	1.64E+04	1.64E+04	1.15E+02	Yes	
Cresol, o- (Methylphenol, 2)	95-48-7	3.30E-01		5.02E+04	-	5.02E+04	1.00E+06	-	1.00E+06	5.02E+04	No	
Cresol, p- (Methylphenol, 4)	106-44-5	3.30E-01		5.15E+03	-	5.15E+03	1.85E+04	-	1.85E+04	5.15E+03	No	
Cyanide (CN-)	57-12-5	1.16E+03	7.00E-01	1.64E+04	-	1.64E+04	6.58E+04	-	6.58E+04	1.64E+04	No	No
Dibenz[a,h]anthracene	53-70-3	2.79E+00		-	1.16E-01	1.16E-01	-	1.64E+01	1.64E+01	1.16E-01	Yes	
Dibenzofuran	132-64-9	2.33E+03		2.10E+03	-	2.10E+03	7.46E+03	-	7.46E+03	2.10E+03	Yes	
Dibromochloromethane	124-48-1	9.00E-02		2.05E+04	3.41E+01	3.41E+01	7.37E+05	3.07E+03	3.07E+03	3.41E+01	No	
Dibutyl Phthalate	84-74-2	5.82E+04		1.07E+05	-	1.07E+05	1.00E+06	-	1.00E+06	1.07E+05	No	
Dichlorobenzene, 1,2-	95-50-1	2.00E+02		3.79E+03	-	3.79E+03	3.92E+05	-	3.92E+05	3.79E+03	No	
Dichlorobenzene, 1,3-	541-73-1	2.00E+02		-	-	-	-	-	-	-	No	
Dichlorobenzene, 1,4-	106-46-7	8.48E+02		1.40E+04	1.23E+02	1.23E+02	4.91E+05	1.09E+04	1.09E+04	1.23E+02	Yes	
Dichlorobenzidine, 3,3'-	91-94-1	3.00E+00		-	6.24E+00	6.24E+00	-	5.68E+02	5.68E+02	6.24E+00	No	
Dichlorodiphenyl Dichloroethane, p, p' (DDD)	72-54-8	1.00E+02		2.08E+03	1.21E+01	1.21E+01	7.42E+03	1.08E+03	1.08E+03	1.21E+01	Yes	
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	9.00E+01		-	8.55E+00	8.55E+00	-	7.64E+02	7.64E+02	8.55E+00	Yes	
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	9.00E+01		4.43E+02	7.16E+00	7.16E+00	1.72E+03	7.02E+02	7.02E+02	7.16E+00	Yes	
Dichloroethane, 1,1-	75-34-3	4.78E+03		1.97E+03	-	1.97E+03	2.17E+05	-	2.17E+05	1.97E+03	Yes	
Dichloroethane, 1,2-	107-06-2	1.00E-02		2.13E+04	7.90E-01	7.90E-01	7.52E+04	2.11E+02	2.11E+02	7.90E-01	No	
Dichloroethylene, 1,1-	75-35-4	1.00E-02		4.00E+02	1.10E-01	1.10E-01	3.99E+03	2.96E+01	2.96E+01	1.10E-01	No	
Dichloroethylene, 1,2-cis-	156-59-2	7.00E-02		1.07E+04	-	1.07E+04	3.76E+05	-	3.76E+05	1.07E+04	No	
Dichloroethylene, 1,2-trans-	156-60-5	1.00E+04		2.08E+02	-	2.08E+02	2.35E+03	-	2.35E+03	2.08E+02	Yes	
Dichlorophenol, 2,4-	120-83-2	3.30E-01		3.15E+03	-	3.15E+03	1.12E+04	-	1.12E+04	3.15E+03	No	
Dichloropropane, 1,2-	78-87-5	1.00E-02		2.67E+01	4.29E+01	2.67E+01	9.78E+02	3.83E+03	9.78E+02	2.67E+01	No	
Dichloropropene, 1,3- (cis + trans)	542-75-6	1.00E-02		2.10E+04	-	2.10E+04	7.46E+05	-	7.46E+05	2.10E+04	No	
Dieldrin	60-57-1	2.00E+00		5.02E+01	1.60E-01	1.60E-01	1.83E+02	1.55E+01	1.55E+01	1.60E-01	Yes	
Diethyl Phthalate	84-66-2	1.00E+04		8.46E+05	-	8.46E+05	1.00E+06	-	1.00E+06	8.46E+05	No	
Dimethyl Phthalate	131-11-3	3.00E+01		1.00E+06	-	1.00E+06	1.00E+06	-	1.00E+06	1.00E+06	No	
Dimethylphenol, 2,4-	105-67-9	1.00E+04		2.01E+04	-	2.01E+04	7.30E+05	-	7.30E+05	2.01E+04	No	
Dinitrophenol, 2,4-	51-28-5	8.00E-01		2.13E+03	-	2.13E+03	7.52E+03	-	7.52E+03	2.13E+03	No	
Dinitrotoluene, 2,4-	121-14-2	3.30E-01		1.27E+03	2.61E+00	2.61E+00	5.69E+03	2.93E+02	2.93E+02	2.61E+00	No	
Di-n-Octyl Phthalate	117-84-0	1.16E+03		-	-	-	-	-	-	-	No	
Endosulfan	115-29-7	6.00E+01		6.02E+03	-	6.02E+03	2.19E+04	-	2.19E+04	6.02E+03	No	
Endosulfan II	891-86-1	2.00E-01		-	-	-	-	-	-	-	No	
Endrin	72-20-8	5.82E+01		7.92E+01	-	7.92E+01	4.65E+02	-	4.65E+02	7.92E+01	No	
Ethylbenzene	100-41-4	7.00E-01		9.26E+03	2.58E+01	2.58E+01	8.94E+04	7.26E+03	7.26E+03	2.58E+01	No	
Fluoranthene	206-44-0	1.00E+04		1.21E+04	-	1.21E+04	6.86E+05	-	6.86E+05	1.21E+04	No	
Fluorene	86-73-7	1.00E+04		1.67E+04	-	1.67E+04	8.70E+05	-	8.70E+05	1.67E+04	No	
Heptachlor	76-44-8	7.00E+00		5.20E+02	5.28E-01	5.28E-01	1.86E+03	5.39E+01	5.39E+01	5.28E-01	Yes	

Table 3-6
Comparision of DSRP Soil Target Cleanup Levels (1999), 2007 ORNL RAIS Risk Based Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Risk Based Excavation Soil PRGs

				2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs					
Analyte	CAS No.	DSRP STCLs Inside Flightline (Human Only) 0-15 ft bgs (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than the DSRP STCL?	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than MMR Background (Inorganics Only)?
Heptachlor Epoxide	1024-57-3	2.52E+00		1.35E+01	2.65E-01	2.65E-01	4.83E+01	2.68E+01	2.68E+01	2.65E-01	Yes	
Hexachlorobenzene	118-74-1	1.27E+01		8.03E+02	3.20E-01	3.20E-01	3.65E+02	6.51E+01	6.51E+01	3.20E-01	Yes	
Hexachlorobutadiene	87-68-3	3.00E+00		2.01E+02	1.71E+00	1.71E+00	2.44E+03	4.36E+02	4.36E+02	1.71E+00	Yes	
Hexachlorocyclohexane, Alpha- (BHC)	319-84-6	1.08E+01		-	3.88E-01	3.88E-01	-	3.91E+01	3.91E+01	3.88E-01	Yes	
Hexachlorocyclohexane, Beta- (BHC)	319-85-7	3.77E+01		-	1.52E+00	1.52E+00	-	1.42E+02	1.42E+02	1.52E+00	Yes	
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	5.22E+01		2.68E+02	1.92E+00	1.92E+00	1.03E+04	1.86E+02	1.86E+02	1.92E+00	Yes	
Hexachloroethane	67-72-1	3.00E+01		1.00E+03	3.14E+01	3.14E+01	3.65E+04	6.65E+03	6.65E+03	3.14E+01	No	
Hexanone, 2	591-78-6	2.33E+03		-	-	-	-	-	-	-	No	
Indeno[1,2,3-cd]pyrene	193-39-5	2.79E+01		-	1.16E+00	1.16E+00	-	1.64E+02	1.64E+02	1.16E+00	Yes	
Isophorone	78-59-1	2.14E+04		2.01E+05	2.96E+03	2.96E+03	1.00E+06	2.69E+05	2.69E+05	2.96E+03	Yes	
Lead and Compounds	7439-92-1	1.00E+03	9.90E+01	-	-	-	-	-	-	-	No	No
Manganese (Water)	7439-96-5	8.14E+03	1.08E+02	3.19E+04	-	3.19E+04	1.77E+04	-	1.77E+04	1.77E+04	No	No
Mercury, Inorganic Salts	7487-94-7	1.75E+01	6.00E-02	3.11E+02	-	3.11E+02	1.11E+03	-	1.11E+03	3.11E+02	No	No
Methoxychlor	72-43-5	9.70E+02		5.02E+03	-	5.02E+03	1.83E+04	-	1.83E+04	5.02E+03	No	
Methyl Ethyl Ketone (2-Butanone)	78-93-3	1.00E+04		-	-	-	-	-	-	-	No	
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	108-10-1	5.00E-01		-	-	-	-	-	-	-	No	
Methylene Chloride (Dichloromethane)	75-09-2	1.00E-02		9.87E+03	2.19E+01	2.19E+01	8.30E+04	5.50E+03	5.50E+03	2.19E+01	No	
Methylnaphthalene, 2-	91-57-6	7.00E-01		4.20E+03	-	4.20E+03	1.49E+04	-	1.49E+04	4.20E+03	No	
Naphthalene	91-20-3	2.33E+03		2.61E+02	-	2.61E+02	2.85E+03	-	2.85E+03	2.61E+02	Yes	
Nickel Soluble Salts	7440-02-0	1.16E+03	5.20E+00	2.22E+04	-	2.22E+04	7.66E+04	-	7.66E+04	2.22E+04	No	No
Nitroaniline, 2	88-74-4	8.00E-01		5.19E+01	-	5.19E+01	3.85E+03	-	3.85E+03	5.19E+01	No	
Nitroaniline, 3	99-09-2	8.00E-01		3.15E+02	1.40E+02	1.40E+02	1.12E+03	1.24E+04	1.12E+03	1.40E+02	No	
Nitrobenzene	98-95-3	1.74E+02		1.58E+02	-	1.58E+02	1.08E+04	-	1.08E+04	1.58E+02	Yes	
Pentachlorophenol	87-86-5	1.70E+02		1.29E+04	1.00E+01	1.00E+01	6.64E+04	1.29E+03	1.29E+03	1.00E+01	Yes	
Phenanthrene	85-01-8	2.33E+03		-	-	-	-	-	-	-	No	
Phenol	108-95-2	1.00E+04		3.17E+05	-	3.17E+05	1.00E+06	-	1.00E+06	3.17E+05	No	
Polychlorinated biphenyls (PCBs)	1336-36-3	NA				0.00E+00			0.00E+00	0.00E+00	Yes	
Pyrene	129-00-0	1.00E+04		9.04E+03	-	9.04E+03	5.14E+05	-	5.14E+05	9.04E+03	Yes	
Selenium	7782-49-2	2.91E+02	3.30E-01	5.59E+03	-	5.59E+03	1.92E+04	-	1.92E+04	5.59E+03	No	No
Silver	7440-22-4	2.91E+02	2.40E+00	5.48E+03	-	5.48E+03	1.90E+04	-	1.90E+04	5.48E+03	No	No
Styrene	100-42-5	1.00E-01		1.62E+04	-	1.62E+04	3.30E+05	-	3.30E+05	1.62E+04	No	
Tetrachloroethane, 1,1,2,2-	79-34-5	2.00E+01		6.23E+04	1.03E+00	1.03E+00	2.23E+05	2.52E+02	2.52E+02	1.03E+00	Yes	
Tetrachloroethylene	127-18-4	1.00E-02		1.79E+03	1.30E+00	1.30E+00	2.27E+04	2.41E+02	2.41E+02	1.30E+00	No	
Thallium (Soluble Salts)	7440-28-0	4.65E+01	2.50E-01	-	-	-	-	-	-	-	No	No
Toluene	108-88-3	1.00E+00		2.60E+04	-	2.60E+04	7.74E+04	-	7.74E+04	2.60E+04	No	
Toxaphene	8001-35-2	1.70E-01		-	2.49E+00	2.49E+00	-	2.31E+02	2.31E+02	2.49E+00	No	
Trichlorobenzene, 1,2,4-	120-82-1	5.78E+02		1.73E+02	-	1.73E+02	3.62E+04	-	3.62E+04	1.73E+02	Yes	
Trichloroethane, 1,1,1-	71-55-6	2.00E-01		5.78E+03	-	5.78E+03	3.53E+05	-	3.53E+05	5.78E+03	No	

Table 3-6
Comparision of DSRP Soil Target Cleanup Levels (1999), 2007 ORNL RAIS Risk Based Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Risk Based Excavation Soil PRGs

				2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs					
Analyte	CAS No.	DSRP STCLs Inside Flightline (Human Only) 0-15 ft bgs (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than the DSRP STCL?	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than MMR Background (Inorganics Only)?
Trichloroethane, 1,1,2-	79-00-5	1.00E-02		4.20E+03	2.05E+00	2.05E+00	1.49E+05	5.30E+02	5.30E+02	2.05E+00	No	
Trichloroethylene	79-01-6	1.00E-02		9.15E+01	8.99E-02	8.99E-02	6.14E+02	2.46E+01	2.46E+01	8.99E-02	No	
Trichlorophenol, 2,4,5-	95-95-4	3.00E+00		1.00E+05	-	1.00E+05	1.00E+06	-	1.00E+06	1.00E+05	No	
Trichlorophenol, 2,4,6-	88-06-2	3.00E+00		-	2.05E+02	2.05E+02	-	2.15E+04	2.15E+04	2.05E+02	No	
Vanadium, Metallic	7440-62-2	4.07E+02	1.52E+01	4.79E+03	-	4.79E+03	2.08E+04	-	2.08E+04	4.79E+03	No	No
Vinyl Chloride	75-01-4	1.00E-02		1.61E+02	4.25E-01	4.25E-01	1.63E+03	8.14E+01	8.14E+01	4.25E-01	No	
Xylene, Mixture	1330-20-7	1.00E+01		1.05E+03	-	1.05E+03	1.17E+04	-	1.17E+04	1.05E+03	No	
Zinc (Metallic)	7440-66-6	1.00E+04	1.60E+01	3.30E+05	-	3.30E+05	1.00E+06	-	1.00E+06	3.30E+05	No	No

Note:
(1) The reported concentration for the DSRP STCL for Chromium is based on Total Chromium not Chromium IV.

Key:
DSRP = Drainage Structure Removal Program
ft bgs = feet below ground surface
HI = hazard index
mg/kg = milligrams per kilogram
MMR = Massachusetts Military Reservation
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
STCL = soil target cleanup level

Table 3-7
Comparison of 2007 ORNL RAIS Residential Soil PRGs
to SARAP Inorganics Removal Action Levels

		ORNL RAIS Residential Soil PRGs (May 2007)				
Analyte	**CAS No.**	**Total Soil PRG HI = 1 (mg/kg)**	**Total Soil PRG Risk = 1E-6 (mg/kg)**	**More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)**	**Removal Action Level (mg/kg)**	**Is the RAL More Stringent than the ORNL RAIS Residential Soil PRG?**
Inorganics						
Aluminum	7429-90-5	6.79E+05	-	6.79E+05	8.90E+03	Yes
Arsenic, Inorganic	7440-38-2	1.7E+02	8.8E-01	8.79E-01	7.10E+00	No
Cadmium (Diet)	7440-43-9	5.22E+02	5.31E+03	5.22E+02	1.80E+00	Yes
Chromium VI (particulates)	18540-29-9	1.82E+03	8.0E+02	7.96E+02	1.90E+01	Yes
Copper	7440-50-8	2.88E+04	-	2.88E+04	6.10E+01	Yes
Cyanide (CN-)	57-12-5	1.18E+04	-	1.18E+04	1.00E+00	Yes
Lead and Compounds	7439-92-1	-	-	-	9.90E+01	Yes
Manganese (Water)	7439-96-5	2.66E+04	-	2.66E+04	2.74E+02	Yes
Mercury	7487-94-7	2.07E+02	-	2.07E+02	1.80E-01	Yes
Vanadium	7440-62-2	3.65E+03	-	3.65E+03	4.70E+01	Yes
Zinc (Metallic)	7440-66-6	2.15E+05	-	2.15E+05	6.80E+01	Yes

Key:
HI = hazard index
mg/kg = milligrams per kilogram
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
RAL = removal action level
SARAP = Source Area Remedial Action Program

Table 4-1
5 Year Review Groundwater Sites

No.	Groundwater 5-Year Review Sites	Doc. Type	Doc. Date	Human Risk Assessment
1	Ashumet Valley	Feasibility Study	Jun-07	Residential Exposure
2	CS-4	ROD	Feb-00	Residential Exposure
3	CS-10	RI	Sep-01	Residential Exposure
4	CS-19	IROD	Apr-06	Residential Exposure
5	CS-20	ROD	Feb-00	Residential Exposure
6	CS-21	ROD	Feb-00	Residential Exposure
7	CS-23	ROD	Sep-07	Residential Exposure
8	Eastern Briarwood	ROD	Sep-06	Residential Exposure
9	FS-1	ROD	Apr-00	Residential Exposure
10	FS-12	ROD	Sep-06	Residential Exposure
11	FS-13	ROD	Feb-00	Residential Exposure
12	FS-28	ROD	Oct-00	Residential Exposure
13	FS-29	ROD	Oct-00	Residential Exposure
14	LF-1	ROD	Sep-07	Residential Exposure
15	SD-5	ROD	Sep-06	Residential Exposure
16	Western Aquafarm	ROD	Sep-06	Residential Exposure

Key:
CS = Chemical Spill
FS = Fuel Spill
LF = Landfill
RI = Remedial Investigation
ROD = Record of Decision
SD = Storm Drain

LIST OF TABLES

Table 1-1
All MMR Source Area and Groundwater Sites

Source Area Sites					
CS-1	CS-8	CY-1	FS-8	FS-22	LF-3 USCG
CS-1 USCG	CS-8 USCG	CY-2	FS-9	FS-23	LF-4
CS-2	CS-9	CY-3	FS-10	FS-24	LF-5
CS-2 USCG	CS-10	CY-4	FS-11	FS-25	LF-6
CS-3	CS-10 TWOU	DDOU	FS-12	FS-26	LF-7
CS-3 USCG	CS-11	FS-1	FS-13	FS-27	PFSA
CS-4	CS-12	FS-1 USCG	FS-14	FTA-1	SD-1
CS-4USCG	CS-14	FS-2	FS-15	FTA-2	SD-2
CS-5	CS-15	FS-2 USCG	FS-16	FTA-3	SD-3
CS-5 USCG	CS-16	FS-3	FS-17	LF-1	SD-4
CS-6	CS-17	FS-4	FS-18	LF-1 USCG	SD-5
CS-6 USCG	CS-18	FS-5	FS-19	LF-2	
CS-7	CS-19	FS-6	FS-20	LF-2 USCG	
CS-7 USCG	CS-22	FS-7	FS-21	LF-3	
Groundwater Sites					
Ashumet Valley	CS-19	CS-23	FS-12	FS-29	Western Aquafarm
CS-4	CS-20	Eastern Briarwood	FS-13	LF-1	
CS-10	CS-21	FS-1	FS-28	SD-5	

Key:
CS = Chemical Spill
DDOU = Drum Disposal Operable Unit
FS = Fuel Spill
LF = Landfill
MMR = Massachusetts Military Reservation
PFSA = Petroleum Fuel Storages Area
TWOU = Tank Wash Operable Unit
USCG = U.S. Coast Guard

Table 1-2
Issue Description and Recommendation/Follow-Up Action

Site #	Issue Description	Issue Summary	Recommendation/ Follow-Up Action	Recommendation/Follow-Up Action Summary	Recommendation Implementation Date	Responsible Party
Source Area Sites						
Multiple IRP Sites (**See Note 1**)	Institutional Controls – other issue	Requirement for LUCs need to determined.	Institutional Controls – Other Recommendation	Evaluate existing access restrictions, land use, implemented remedies, etc., to determine if LUCs are required.	December, 2011	AFCEE
CS-4 USCG/ FS-1 USCG	Change in ARAR/ cleanup levels	The new MassDEP soil standards for benzo(a)pyrene and dibenz(a,h)anthracene could potentially affect the protectiveness of the removal action.	Re-evaluate risk-based cleanup levels	Determine if existing cleanup levels remain protective.	December, 2011	AFCEE
CS-18	Other issue (Uncategorized)	Cleanup levels and confirmation sampling approach have not been established for explosive constituents at CS-18.	Establish cleanup criteria	A final decision regarding CS-18 needs to be made and implemented.	December, 2011	AFCEE
CS-19	Other issue (Uncategorized)	AFCEE and regulatory agencies have agreed to cleanup the source area soil contamination by conducting a non-time critical removal action focusing on eliminating the source of the RDX plume. Cleanup levels have not been established for other explosive constituents at CS-19.	Establish cleanup criteria	A final decision regarding CS-18 needs to be made and implemented.	December, 2011	AFCEE
CY-2	Other issue (Uncategorized)	EPA has not concurred with the no further action Decision Document.	Other recommendations (uncategorized)	EPA needs to review the no further action decision document.	December, 2011	AFCEE
FS-2 USCG	Change in ARAR/ cleanup levels	The new MassDEP soil standards for PAHs could potentially affect the protectiveness of the no further action decision.	Re-evaluate risk-based cleanup levels	Determine if existing cleanup levels remain protective.	December, 2011	AFCEE
FS-7	Change in ARAR/ cleanup levels	The new MassDEP S-1/GW-1 standards for benzo(a)pyrene and dibenz(a,h)anthracene could potentially affect the protectiveness of the removal action.	Re-evaluate risk-based cleanup levels	Determine if existing cleanup levels remain protective.	December, 2011	AFCEE
FTA-2/LF-2	Additional contamination was found	EPH/VPH have been identified as contaminants in subsurface soil and groundwater.	Define extent of additional contamination	Exposure to contaminated groundwater is not an immediate threat to human health based on current land and groundwater use.	December, 2011	AFCEE
LF-1	Other issue (Uncategorized)	ROD did not address NWOU due to former gun position located in same area.	Resolve regulatory approach for gun position	The Air Force, Army, EPA, and MassDEP should develop a plan to resolve the gun position issue on the NWOU with the ultimate objective of modifying the LF-1 remedy decision to include the NWOU cells.	December, 2011	AFCEE
PFSA/FS-10/ FS-11	Additional contamination was found	EPH/VPH have been identified as contaminants in subsurface soil and groundwater.	Define extent of additional contamination	Exposure to contaminated groundwater is not an immediate threat to human health based on current land and groundwater use.	December, 2011	AFCEE
SD-1	Other issue (Uncategorized)	MassDEP raised a concern regarding PAH concentrations in soil.	Conduct risk assessment	AFCEE has a submitted a Project Note to collect soil samples and perform a risk assessment in order to confirm that no further action is required for unrestricted use.	December, 2011	AFCEE
SD-4	Change in ARAR/ cleanup levels	Groundwater may need to be reevaluated. The calculated noncancer HI for groundwater, which is based on residential exposure scenarios, exceeded the EPA threshold of 1.0. Primary contributors include isomers of trimethylbenzene. No further action is required for other media based on results of the RI human health risk assessment, Post-ROD sampling results, and Post-ROD ecological risk analyses.	Re-evaluate risk-based cleanup levels	Trimethylbenzene is classified and regulated by the MassDEP as C_{11}-C_{22} aromatic hydrocarbons.	December, 2011	AFCEE

Table 1-2
Issue Description and Recommendation/Follow-Up Action

Site #	Issue Description	Issue Summary	Recommendation/ Follow-Up Action	Recommendation/Follow-Up Action Summary	Recommendation Implementation Date	Responsible Party
Groundwater Sites						
AV	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
CS-4	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
CS-10	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue and recommendations.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Contaminant plume not contained	The Interim remedial system is not functioning as intended since a portion of the CS-10 plume in the southern trench area has moved beyond the base boundary.	Install additional extraction wells	The Air Force has begun the process to construct an additional extraction well to address the CS-10 southern trench area. Completion of this project is anticipated in late 2008.	December, 2011	AFCEE
CS-19	Changed site condition - Other Issue	Final RAOs should be developed as described in Question B; review of RAOs.	Adjust Remedial Action Objectives prior to insertion in Final ROD	The Interim RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness when the final ROD for CS-19 is developed in 2009.	December, 2011	AFCEE
CS-20	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
CS-21	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
CS-23	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Monitoring - Other	Monitoring and evaluation activities have indicated excessive drawdown of surface water at a nearby wetland and vernal pool.	Continue monitoring	The Air Force will continue to monitor the wetland and vernal pool near CS-23 for potential negative ecological impacts associated with the surface water drawdown.	December, 2011	AFCEE
FS-1	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE

Table 1-2
Issue Description and Recommendation/Follow-Up Action

Site #	Issue Description	Issue Summary	Recommendation/ Follow-Up Action	Recommendation/Follow-Up Action Summary	Recommendation Implementation Date	Responsible Party
FS-12	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
FS-28	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
FS-29	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE
LF-1	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Monitoring - Other	Monitoring and evaluation activities have indicated excessive drawdown of surface water at a nearby wetland and vernal pool.	Continue monitoring	The Air Force will continue to monitor the wetland and vernal pool near CS-23 for potential negative ecological impacts associated with the surface water drawdown.	December, 2011	AFCEE
SD-5	Institutional Controls – other issue	See Section 4.3 for a full discussion of the LUC issue.	Institutional Controls – other recommendation	See Section 4.3 for a full discussion of the LUC recommendations.	December, 2011	AFCEE
	Changed site condition - Other Issue	RAOs should be modified as described in Question B; review of RAOs.	Adjust Remedial Action Objectives	The RAOs currently require the Air Force to "prevent or reduce residential exposure." This RAO should be modified to eliminate the word "reduce" to better ensure long-term protectiveness.	December, 2011	AFCEE

Note 1: CS-1, CS-2 USCG, CS-4 USCG/FS-1 USCG, CS-5, CS-6/FS-22, CS-6 USCG, CS-10/FS-24, CS-11, CS-14, CS-15, CS-16/CS-17, CY-1/CY-3, CY-2, DDOU, FS-1, FS-2 USCG, FS-3, FS-4, FS-7, FS-9, FS-12, FS-18, FS-25, FTA-1, FTA-2/LF-2, PFSA/FS-10/FS-11, SD-1, SD-2/FS-6/FS-8, SD-3/FTA-3/CY-4, SD-4, and SD-5/FS-5.

Key:
AFCEE = Air Force Center for Engineering and the Environment
ARAR = applicable or relevant and appropriate requirement
AV = Ashumet Valley
CS = Chemical Spill
DDOU = Drum Disposal Operable Unit
EPA = U.S. Environmental Protection Agency
EPH = extractable petroleum hydrocarbon
FS = Fuel Spill
FTA = Fire Training Area
HI = hazard index
IRP = Installation Restoration Program
LF = Landfill
LUC = Land Use Control
MassDEP = Massachusetts Department of Environmental Protection
NWOU = Northwest Operable Unit
PAH =polynuclear aromatic hydrocarbon
PFSA = Petroleum Fuels Storage Area
RAO = Remedial/Removal Action Objective
RDX = Royal Demolition Explosive
RI = Remedial Investigation
ROD = Record of Decision
SD = Storm Drain
VPH =volatile petroleum hydrocarbon
USCG = U.S. Coast Guard

Table 2-1
No Further Action Sites
No 5-Year Review Required

No.	Site No.	Doc. Type	Document Date	NFA Based on PA (No Sampling)	NFA Based on SI (Sampling)	NFA Based on SI (Sampling & Risk Analysis)	NFA Based on RI	NFA Based on Remedial/ Removal Action	Comments
1	CS-1 USCG	ROD	Sep-95				X		
2	CS-2	DD	Oct-00			X			Excavation completed as part of DSRP.
3	CS-3/FS-23	DD	Apr-00			X			Other activities included the removal of structures as part of DSRP, UST removal, and Fuels Upgrade Program.
4	CS-3 USCG	ROD	Sep-98				X		1985 UST and contaminated soil removed from site. 340 cubic yards excavation completed as part of 1994 Fuel Systems Upgrade Program. Drainage structure abandoned in place during DSRP.
5	CS-5 USCG	DD	Aug-90	X					
6	CS-7	DD	Aug-90	X					
7	CS-7 USCG	DD	Aug-90	X					
8	CS-8	DD	Oct-00			X			UST removed and excavation completed as part of DSRP.
9	CS-9	DD	Jun-98				X		Structures and associated soil removed as part of DSRP.
10	CS-10 TWOU	DD	Feb-90		X				
11	CS-12	DD	Aug-90	X					
12	FS-2	ROD	Feb-02				X		520 tons of soil were removed and treated by a low thermal treatment system in 1996.
13	FS-14	DD	Apr-00			X			
14	FS-15	DD	Aug-90	X					
15	FS-16	DD	Aug-90	X					
16	FS-17/FS-19	ROD	Oct-99				X		Activities conducted included removals under the DSRP and Fuel Systems Upgrade Program.
17	FS-20	DD	Feb-90		X				
18	FS-21	DD	Oct-00			X			Current Product Tank removed.
19	FS-26	DD	Jul-97		X				UST Removal and no contamination below 15 feet below ground surface.
20	FS-27	DD	Dec-00			X			
21	LF-1 USCG	DD	Dec-95			X			
22	LF-2 USCG	DD	Aug-90	X					
23	LF-3	DD	Apr-97	X					
24	LF-3 USCG	DD	Aug-90	X					
25	LF-4	DD	Nov-00			X			
26	LF-5	DD	Aug-90	X					
27	LF-6	DD	Aug-90	X					

Key:
CS = Chemical Spill
DD = Decision Document
DSRP = Drainage Structure Removal Program
FS = Fuel Spill
LF = Landfill
NFA = No Further Action
PA = Prleiminary Assessment
ROD = Record of Decision
SI = Site Investigaton/Inspection
TWOU - Tank Washing Operable Unit
USCG = U.S. Coast Guard
UST = underground storage tank

Table 3-1
Installation Restoration Program Source Area Sites Requiring Five-Year Review

No.	Source Area Site	Document Type	Most Stringent Exposure Scenario	Soil PRE Performed?	Soil PRA Performed?	DSRP	Other Action	Is Risk Analysis Valid?	Protective/Issues
1	CS-1	DD	Worker (0-10 ft bgs)	Yes	No	Yes	Yes	TBD	Determine if site is allowable for unrestricted use.
2	CS-2 USCG	DD	Worker (0-2 ft bgs) (No evaluation for subsurface soil in SI)	Yes (see Table-3-3)	No	Yes	Yes	Surface Soil -yes. Subsurface Soil - TBD	Determine if site is allowable for unrestricted use.
3	CS-4	AM	Residential (0-15 ft bgs)	Yes	No	Yes	Yes- SARAP	Some screening levels were exceeded however removal action was implemented. RALs are more stringent than current PRGs and also take into consideration background.	Implementation of the removal action allows for unrestricted use.
4	CS-4 USCG/FS-1 (USCG)	AM	Worker (0-2 ft bgs) No evaluation for subsurface soil	Yes (see Table-3-3)	No	Yes	Yes-SARAP	TBD	Determine if site is allowable for unrestricted use.
5	CS-5	AM	Residential (surface) Worker (Subsurface)	Yes	Yes, Residential exceed $1x10^{-4}$. Worker (subsurface soil < $1x10^{-5}$ & HI<1)	Yes	Yes-SARAP	TBD	Determine if site is allowable for unrestricted use.
6	CS-6/FS-22	DD	Residential (surface) Worker (Subsurface)	Worker (2-10 ft bgs)	Yes , Residential risk was $1.44x10^{-5}$ and HI<1	No	Yes- Sump	Residential PRA is valid. Worker PRE TBD.	Determine if site is allowable for unrestricted use.
7	CS-6 USCG	DD	Residential (0-2 ft.bgs) Worker (2-10 ft bgs))	Yes (see Table 3-2 & Table 3-3)	No	No	No	PAHs in surface soil exceeds residential Tier I HECs.	Determine if site is allowable for unrestricted use. Risk management decision to not address PAHs in surface soil.
8	CS-8 USCG		Residential (0-10 ft bgs)	2001 EPA Region IX PRGs were used for screening. Some current EPA PRGs exceed 2001 PRGs	No	No	Yes-SARAP	Some screening levels were exceeded however removal action was implemented. RALs are more stringent than current PRGs and also take into consideration background.	Implementation of the removal action allows for unrestricted use.
9	CS-10/FS-24	Remedial Action Report needs to completed.							
10	CS-11	AM	Residential (0-2 ft bgs) (No evaluation for subsurface soil)	Yes (see Table-3-2)	No	No	Yes-SARAP	TBD	Determine if site is allowable for unrestricted use.
11	CS-14	DD	Worker	PRE was performed but should be reevaluated.	No	Yes	Yes-Sump	Evaluate data - PRE may not be representative of site conditions.	Determine if site is allowable for unrestricted use.
12	CS-15	DD	Worker (0-10 ft.bgs)	Yes (modified) calculated risk is $1x10^{-6}$ and HI <1	Yes (modified) calculated risk is $1x10^{-6}$ and HI <1	Yes	No	Modified PRA is valid.	TBD-Cleanup
13	CS-16/CS-17	ROD	Residential (0-2 ft bgs) (No evaluation for subsurface soil)	N/A	Yes , Residential risk was $4.0x10^{-5}$ and HI<1	No	Yes-SARAP	SARAP Cleanup performed-impacts risk analysis	Determine if site is allowable for unrestricted use.
14	CS-18	Decision not determined and/or remedy not fully implemented							
15	CS-19	Decision not determined and/or remedy not fully implemented							
16	CS-22	AM	Residential (0-10 ft bgs)	2001 EPA Region IX PRGs were used for screening. Some current EPA PRGs exceed 2001 PRGs.	No	No	Yes-SARAP	Some screening levels were exceeded however removal action was implemented. RALs are more stringent than current PRG and also take into consideration background.	Implementation of the removal action allows for unrestricted use.

Table 3-1
Installation Restoration Program Source Area Sites Requiring Five-Year Review

No.	Source Area Site	Document Type	Most Stringent Exposure Scenario	Soil PRE Performed?	Soil PRA Performed?	DSRP	Other Action	Is Risk Analysis Valid?	Protective/Issues
17	CY-1/CY-3	DD	Compared to SARAP ecological risk-based RALS	No	No	No	No	SARAP RALs more stringent than current residential risk-based PRGs.	Worker PRA for CY-4 takes into consideration surface soil. Determine if site is allowable for unrestricted use.
18	CY-2	DD	Not Evaluated	N/A	N/A	No	N/A	N/A	Site conditions have changed due to construction of waste transfer station. AFCEE will reevaluate data used in the DD to determine if site characterization accurately represents site.
19	DDOU	AM	Not Evaluated	N/A	N/A	No	Yes-SARAP	TBD	Evaluate if soil is allowable for unrestricted use.
20	FS-1 (soil)	ROD	Worker	Yes	TBD, exposure assessment for soil performed but no risk or HI calculated	No	No	TBD	Evaluate if soil is allowable for unrestricted use.
21	FS-2 (USCG)	DD	Residential (0-2 ft bgs) Worker (0-10 ft bgs)	Yes-residential (see Table-3-2), worker-needs to be reevaluated	No	No	No	PAHs in surface soil exceeds worker Tier I .	Potential overestimation of Risk (surface soil data used in subsurface PRE). NFA for surface soil was based on biased sampling of asphalt-like substance.
22	FS-3	DD	Residential (0-2 ft bgs) Worker (0-10 ft bgs)	Yes-residential (see Table-2), worker-needs to be reevaluated	No	No	No	Metals in surface soil exceeds residential Tier I HECs.	Potential overestimation of Risk (surface soil data used in subsurface PRE). NFA for surface soil was based on comparison of COCs with background.
23	FS-4	AM	Worker (0-10 ft.bgs)	Yes (see Table-3-3)	No	No	Yes-FSUP	Yes.	Evaluate if soil is allowable for unrestricted use.
24	FS-7	AM	Residential (0-2 ft bgs) (No evaluation for subsurface soil)	Yes (see Table-3-2)	No	No	Yes-SARAP	PAHs exceeded Tier I residential HECs	SARAP cleanup was eco-risk based. Evaluate if soil is allowable for unrestricted use.
25	FS-9	ROD	Residential (0-2 ft bgs) Worker (0-10 ft bgs)	No	Yes, Residential is $2.2x10^{-5}$. Worker (subsurface soil < $1x10^{-5}$ & HI<1)	Yes	Yes-SARAP	Yes.	Evaluate if subsurface soil is allowable for unrestricted use.
26	FS-12	AM	Surface soil not evaluated. Subsurface soil evaluated based on worker.	No	Yes, Worker (subsurface soil < $1x10^{-5}$ & HI<1)	No	Yes	PRA is valid.	Remedy includes groundwater monitoring. Evaluate if soil is allowable for unrestricted use.
27	FS-13 Soil	DD	Residential (0-15 ft bgs)	2004 EPA Region IX PRGs were used. Comparison to current EPA PRGs not made because risk management was used for decision-making process.	No	No	No	Some screening levels were exceeded however detection frequency, comparison to background, etc., was evaluated for NFA -unrestricted use decision.	Allowable for unrestricted use
28	FS-18	AM	Residential (0-2 ft bgs) Worker (0-10 ft bgs)	Yes-residential (see Table-3-2), worker-needs to be reevaluated	No	Yes	No	NFA based on SARAP delineation sampling.	Remedial Design sampling supported NFA. Evaluate if subsurface soil is allowable for unrestricted use.
29	FS-25	DD	Worker (subsurface)	N/A	Yes, Residential (0-2 ft bgs 4x10-5 & HI<1) Worker (0-10 ft bgs < 1x10-5 & HI<1)	No	Yes	Yes	Determine if site is allowable for unrestricted use based on existing subsurface soil data.

Table 3-1
Installation Restoration Program Source Area Sites Requiring Five-Year Review

No.	Source Area Site	Document Type	Most Stringent Exposure Scenario	Soil PRE Performed?	Soil PRA Performed?	DSRP	Other Action	Is Risk Analysis Valid?	Protective/Issues
30	FTA-1	AM	Child Trespasser (0-2 ft bgs)			Yes	Yes		Determine if site is allowable for unrestricted use based on existing soil data.
31	FTA-2/LF-2	ıder Investigation- Potential Change in Remedy							
32	LF-1	ROD	Soil not evaluated- waste left in place	N/A	N/A	No	Yes	N/A	Landfill Cap and engineering controls in place. Groundwater monitored.
33	LF-7	DD	Soil not evaluated	N/A	N/A	No	No	No	Monitoring for radioactivity. Closure plan needs to be identified .
34	PFSA/FS-10/FS-11	ıder Investigation- Potential Change in Remedy							
35	SD-1	MassDEP has concerns regarding PAHs							
36	SD-2/FS-6/FS-8	ROD	Residential (0-2 ft bgs) Subsurface soil not evaluated	Yes	Yes, Residential (0-2 ft bgs 4x10-5 & HI<1) Worker (0-10 ft bgs < 1x10-5 & HI<1)	No	Yes-SARAP	Yes and SARAP Cleanup performed would likely lower calculated risk and HI.	Determine if site is allowable for unrestricted use based on existing subsurface soil data.
37	SD-3/FTA-3/CY-4	ROD	Trespasser (0-2 ft bgs) Worker (0-10 ft bgs)	Yes	Yes, Trespasser (0-2 ft bgs < 1x10-5 & HI<1) Worker (0-10 ft bgs < 1x10-5 & HI<1)	Yes	Yes-SARAP	SARAP Cleanup performed-impacts risk analysis	Worker PRA takes into consideration surface soil. Furthermore SARAP remedial action addressed eco-risk. Determine if site is allowable for unrestricted use.
38	SD-4	ROD	Residential (0-2 ft bgs) Subsurface soil not evaluated	No	Yes, Residential is $9.9x10^{-5}$ & HI<1) Primary contributors are arsenic and beryllium (found in background)	Yes	No	NFA based on SARAP ecological risk analysis.	Finalize RAR and ESD. Determine if subsurface soil is allowable for unrestricted use. Address TMB in groundwater.
39	SD-5/FS-5	Remedial Action Report needs to completed.							

Notes:
Sites highlighted in Red: Protectiveness and Technical Assessment to be determined because of issues listed.
Sites highlighted in Green: Site has been investigated and/or action performed in 2002-2007 and meets unrestricted use requirements .

Key:
AFCEE = Air Force Center for Engineering and the Environment
AM = Action Memorandum
CS = Chemical Spill
CY = Coal Yard
DD = Decision Document
DDOU = Drum Disposal Operable Unit
DSRP = Drainage Structure Removal Program
EPA = U.S. Environmental Protection Agency
FS = Fuel Spill
FSUP = Fuel Systems Upgrade Program
ft bgs = feet below ground surface
HI = hazard index
MassDEP = Massachusetts Department of Environmental Protection
NFA = No Further Action
PRA = preliminary risk assessment
PRE = preliminary risk evaluation
PRG = Preliminary Remediation Goals
RAL = removal action level
ROD = Record of Decision
SARAP = Source Area Remedial Action Program
SI = Site Investigation/Inspection
TBD = To Be Determined
USCG = U.S. Coast Guard

Table 3-2
Comparison of Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil & ORNL RAIS Residential Soil PRGs

		Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil			ORNL RAIS Residential Soil PRGs			Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Residential Soil PRG?
Analyte	CAS No.	Residential Tier I Outside Cancer	Residential Tier I Outside Non-Cancer	More Stringent Cancer vs. Non-Cancer	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs Risk = 1E-6	
Acenaphthene	83-32-9	7.38E-02	2.77E+03	7.38E-02	1.64E+04	-	1.64E+04	Yes
Acetone	67-64-1	-	1.91E+03	1.91E+03	6.27E+05	-	6.27E+05	Yes
Aldrin	309-00-2	7.72E-02	3.37E+00	7.72E-02	2.03E+01	9.07E-02	9.07E-02	Yes
Anthracene	120-12-7	7.38E-02	1.39E+04	7.38E-02	1.30E+05	-	1.30E+05	Yes
Antimony (metallic)	7440-36-0	-	2.20E+01	2.20E+01	2.43E+02	-	2.43E+02	Yes
Arsenic, Inorganic	7440-38-2	3.66E-01	1.65E+01	3.66E-01	1.70E+02	8.79E-01	8.79E-01	Yes
Barium	7440-39-3	-	3.84E+03	3.84E+03	1.29E+05	-	1.29E+05	Yes
Benz[a]anthracene	56-55-3	7.38E-02	-	7.38E-02	-	8.70E-01	8.70E-01	Yes
Benzene	71-43-2	9.87E-01	-	9.87E-01	3.24E+02	3.25E+00	3.25E+00	Yes
Benzo(g,h,i)perylene	191-24-2	7.38E-02	-	7.38E-02	-	-	-	Yes
Benzo[a]pyrene	50-32-8	7.38E-02	-	7.38E-02	-	8.72E-02	8.72E-02	Yes
Benzo[b]fluoranthene	205-99-2	7.38E-02	-	7.38E-02	-	8.73E-01	8.73E-01	Yes
Benzo[k]fluoranthene	207-08-9	7.38E-02	-	7.38E-02	-	8.73E+00	8.73E+00	Yes
Benzoic Acid	65-85-0	-	1.85E+05	1.85E+05	1.00E+06	-	1.00E+06	Yes
Beryllium and compounds	7440-41-7	1.49E-01	2.74E+02	1.49E-01	1.03E+03	2.83E-01	2.83E-01	Yes
Bis(2-ethylhexyl)phthalate	117-81-7	3.85E+01	9.24E+02	3.85E+01	1.21E+04	1.01E+02	1.01E+02	Yes
Butyl Benzyl Phthlate	85-68-7	-	9.24E+03	9.24E+03	1.37E+05	8.41E+02	8.41E+02	No
Cadmium (Diet)	7440-43-9	4.28E+03	2.74E+01	2.74E+01	5.22E+02	5.31E+03	5.22E+02	Yes
Carbon Tetrachloride	56-23-5	4.78E-01	1.33E+01	4.78E-01	4.81E+02	6.27E-01	6.27E-01	Yes
Chlordane (Gamma)	5103-74-2	1.01E+00	6.75E+00	1.01E+00	-	-	-	Yes
Chlorobenzene	108-90-7	-	3.81E+02	3.81E+02	1.02E+03	-	1.02E+03	Yes
Chloroform	67-66-3	4.26E-01	1.91E+02	4.26E-01	6.09E+03	7.63E-01	7.63E-01	Yes
Chloromethane	74-87-3	7.01E-01	7.62E+01	7.01E-01	3.45E+02	4.77E+00	4.77E+00	Yes
Chromium VI (particulates)	18540-29-9	6.57E+02	2.74E+02	2.74E+02	1.82E+03	7.96E+02	7.96E+02	Yes
Chrysene	218-01-9	7.38E-02	-	7.38E-02	-	8.72E+01	8.72E+01	Yes
Cyanide (CN-)	57-12-5	-	3.81E+02	3.81E+02	1.18E+04	-	1.18E+04	Yes
Dibenz[a,h]anthracene	53-70-3	7.38E-02	-	7.38E-02	-	8.73E-02	8.73E-02	Yes
Dibutyl Phthalate	84-74-2	-	4.62E+03	4.62E+03	7.02E+04	-	7.02E+04	Yes
Dichlorodiphenyl Dichloroethane, p, p' (DDD)	72-54-8	5.47E+00	-	5.47E+00	1.38E+03	6.71E+00	6.71E+00	Yes
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	3.86E+00	-	3.86E+00	-	4.74E+00	4.74E+00	Yes
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	3.86E+00	5.62E+01	3.86E+00	3.12E+02	4.25E+00	4.25E+00	Yes
Dichloroethane, 1,1-	75-34-3	-	2.70E+01	2.70E+01	3.59E+03	-	3.59E+03	Yes

Table 3-2
Comparison of Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil & ORNL RAIS Residential Soil PRGs

		Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil			ORNL RAIS Residential Soil PRGs			Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Residential Soil PRG?
Analyte	CAS No.	Residential Tier I Outside Cancer	Residential Tier I Outside Non-Cancer	More Stringent Cancer vs. Non-Cancer	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs Risk = 1E-6	
Dichloroethane, 1,2-	107-06-2	3.51E-01	5.72E+03	3.51E-01	1.40E+04	1.17E+00	1.17E+00	Yes
Dichloroethylene, 1,1-	75-35-4	6.94E-02	1.72E+02	6.94E-02	7.32E+02	1.64E-01	1.64E-01	Yes
Dichloroethylene, 1,2-trans-	156-60-5	-	3.81E+02	3.81E+02	3.79E+02	-	3.79E+02	No
Dichlorophenol, 2,4-	120-83-2	-	1.39E+02	1.39E+02	2.09E+03	-	2.09E+03	Yes
Dieldrin	60-57-1	8.20E-02	5.62E+00	8.20E-02	3.38E+01	9.52E-02	9.52E-02	Yes
Dinitrotoluene, 2,4-	121-14-2	7.93E-01	9.24E+01	7.93E-01	9.87E+02	1.69E+00	1.69E+00	Yes
Endrin	72-20-8	-	3.37E+01	3.37E+01	7.31E+01	-	7.31E+01	Yes
Ethylbenzene	100-41-4	-	1.06E+03	1.06E+03	1.49E+04	4.00E+01	4.00E+01	No
Ethylene Dibromide (Dibromoethane, 1,2-)	106-93-4	2.56E-03	-	2.56E-03	3.43E+02	1.31E-01	1.31E-01	Yes
Fluoranthene	206-44-0	7.38E-02	1.85E+03	7.38E-02	1.09E+04	-	1.09E+04	Yes
Fluorene	86-73-7	7.38E-02	1.85E+03	7.38E-02	1.43E+04	-	1.43E+04	Yes
Heptachlor	76-44-8	2.92E-01	5.62E-01	2.92E-01	3.46E+02	3.32E-01	3.32E-01	Yes
Heptachlor Epoxide	1024-57-3	1.44E-01	1.46E+00	1.44E-01	8.99E+00	1.65E-01	1.65E-01	Yes
Hexachlorobenzene	118-74-1	3.37E-01	3.70E+01	3.37E-01	5.41E+02	3.75E-01	3.75E-01	Yes
Hexachlorocyclohexane, Alpha- (BHC)	319-84-6	2.08E-01	-	2.08E-01	-	2.41E-01	2.41E-01	Yes
Hexachlorocyclohexane, Beta- (BHC)	319-85-7	7.29E-01	-	7.29E-01	-	8.80E-01	8.80E-01	Yes
Hexanone, 2	591-78-6	-	7.62E+02	7.62E+02	-	-	-	Yes
Indeno[1,2,3-cd]pyrene	193-39-5	7.38E-02	-	7.38E-02	-	8.73E-01	8.73E-01	Yes
Manganese (Water)	7439-96-5	-	2.74E+02	2.74E+02	2.66E+04	-	2.66E+04	Yes
Methoxychlor	72-43-5	-	5.62E+02	5.62E+02	3.38E+03	-	3.38E+03	Yes
Methyl Ethyl Ketone (2-Butanone)	78-93-3	-	8.80E+02	8.80E+02	-	-	-	Yes
Methylene Chloride (Dichloromethane)	75-09-2	7.89E+00	1.14E+03	7.89E+00	1.43E+04	3.08E+01	3.08E+01	Yes
Nickel Soluble Salts	7440-02-0	3.21E+04	1.10E+03	1.10E+03	1.44E+04	-	1.44E+04	Yes
Nitrobenzene	98-95-3	-	2.31E+01	2.31E+01	1.90E+02	-	1.90E+02	Yes
Phenanthrene	85-01-8	7.38E-02	-	7.38E-02	-	-	-	Yes
Phenol	108-95-2	-	2.77E+04	2.77E+04	2.10E+05	-	2.10E+05	Yes
Piperidine, 1- (Phenylcyclohexyl,1-)	77-10-1	4.49E+00	1.39E+03	4.49E+00	-	-	-	Yes
Polychlorinated Biphenyls	27323-18-8	1.70E-01	-	1.70E-01	-	4.88E-01	4.88E-01	Yes
Pyrene	129-00-0	7.38E-02	1.39E+03	7.38E-02	8.19E+03	-	8.19E+03	Yes
Selenium	7782-49-2	-	2.74E+02	2.74E+02	3.62E+03	-	3.62E+03	Yes
Silver	7440-22-4	-	2.74E+02	2.74E+02	3.57E+03	-	3.57E+03	Yes
Tetrachloroethane, 1,1,2,2-	79-34-5	5.50E-01	-	5.50E-01	4.14E+04	1.42E+00	1.42E+00	Yes

Table 3-2
Comparison of Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil & ORNL RAIS Residential Soil PRGs

		Priority 2 and 3 Study Areas SI HECs Human Health Surface Soil			ORNL RAIS Residential Soil PRGs			Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Residential Soil PRG?
Analyte	CAS No.	Residential Tier I Outside Cancer	Residential Tier I Outside Non-Cancer	More Stringent Cancer vs. Non-Cancer	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs Risk = 1E-6	
Tetrachloroethylene	127-18-4	-	1.91E+02	1.91E+02	2.54E+03	1.41E+00	1.41E+00	No
Thallium (Soluble Salts)	7440-28-0	-	4.39E+00	4.39E+00	-	-	-	Yes
Toluene	108-88-3	-	5.38E+02	5.38E+02	3.10E+04	-	3.10E+04	Yes
Trichloroethane, 1,1,2-	79-00-5	1.15E+00	7.62E+01	1.15E+00	2.78E+03	2.96E+00	2.96E+00	Yes
Trichloroethylene	79-01-6	4.66E+00	1.33E+02	4.66E+00	1.07E+02	1.36E-01	1.36E-01	No
Trichloropropane, 1,2,3-	96-18-4	-	1.14E+02	1.14E+02	4.17E+03	2.32E-01	2.32E-01	No
Vinyl Chloride	75-01-4	1.17E-01	-	1.17E-01	2.74E+02	4.74E-01	4.74E-01	Yes
Xylene, Mixture	1330-20-7	-	3.81E+04	3.81E+04	1.93E+03	-	1.93E+03	No
Zinc (Metallic)	7440-66-6	-	1.65E+04	1.65E+04	2.15E+05	-	2.15E+05	Yes

Key:
HEC = hazard equivalent concentration
HI = hazard index
mg/kg = milligrams per kilogram
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
SI = Site Investigation/Inspection

Table 3-3
Comparison of Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil,
2007 ORNL RAIS Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Excavation Soil PRGs

		Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil			2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs				
Analyte	**CAS No.**	**Worker Tier I Cancer (mg/kg)**	**Worker Tier I Non-Cancer (mg/kg)**	**More Stringent Cancer vs. Non-Cancer (mg/kg)**	**Total Soil PRG HI = 1 (mg/kg)**	**Total Soil PRG Risk = 1E-6 (mg/kg)**	**More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)**	**Total Soil PRG HI = 1 (mg/kg)**	**Total Soil PRG Risk = 1E-6 (mg/kg)**	**More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)**	**More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)**	**Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Outdoor Industrial and Excavation Soil PRGs?**
Acenaphthene	83-32-9	3.08E+00	1.93E+04	3.08E+00	1.81E+04	-	1.81E+04	1.00E+06	-	1.00E+06	1.81E+04	Yes
Acetone	67-64-1	-	1.00E+04	1.00E+04	9.47E+05	-	9.47E+05	1.00E+06	-	1.00E+06	9.47E+05	Yes
Aldrin	309-00-2	2.81E+00	2.04E+00	2.04E+00	3.01E+01	1.55E-01	1.55E-01	1.46E+02	1.47E+01	1.47E+01	1.55E-01	No
Anthracene	120-12-7	3.08E+00	9.64E+04	3.08E+00	1.60E+05	-	1.60E+05	1.00E+06	-	1.00E+06	1.60E+05	Yes
Antimony (metallic)	7440-36-0	-	1.70E+01	1.70E+01	3.42E+02	-	3.42E+02	6.73E+02	-	6.73E+02	3.42E+02	Yes
Arsenic, Inorganic	7440-38-2	1.70E+01	1.28E+01	1.28E+01	2.30E+02	1.43E+00	1.43E+00	9.52E+02	1.48E+02	1.48E+02	1.43E+00	No
Barium	7440-39-3	-	2.98E+03	2.98E+03	1.75E+05	-	1.75E+05	2.59E+05	-	2.59E+05	1.75E+05	Yes
Benz[a]anthracene	56-55-3	3.08E+00	-	3.08E+00	-	1.15E+00	1.15E+00	-	1.64E+02	1.64E+02	1.15E+00	No
Benzene	71-43-2	6.83E+01	-	6.83E+01	1.89E+02	2.26E+00	2.26E+00	1.93E+03	5.83E+02	5.83E+02	2.26E+00	No
Benzo(g,h,i)perylene	191-24-2	3.08E+00	-	3.08E+00	-	-	-	-	-	-	-	Yes
Benzo[a]pyrene	50-32-8	3.08E+00	-	3.08E+00	-	1.16E-01	1.16E-01	-	1.64E+01	1.64E+01	1.16E-01	No
Benzo[b]fluoranthene	205-99-2	3.08E+00	-	3.08E+00	-	1.16E+00	1.16E+00	-	1.64E+02	1.64E+02	1.16E+00	No
Benzo[k]fluoranthene	207-08-9	3.08E+00	-	3.08E+00	-	1.16E+01	1.16E+01	-	1.64E+03	1.64E+03	1.16E+01	Yes
Benzoic Acid	65-85-0	-	1.29E+05	1.29E+05	1.00E+06	-	1.00E+06	8.34E+03	-	8.34E+03	8.34E+03	No
Beryllium and compounds	7440-41-7	6.93E+00	2.13E+02	6.93E+00	1.33E+03	4.45E-01	4.45E-01	1.45E+04	4.85E+01	4.85E+01	4.45E-01	No
Bis(2-ethylhexyl)phthalate	117-81-7	1.61E+03	6.43E+02	6.43E+02	1.69E+04	1.69E+02	1.69E+02	6.69E+04	1.67E+04	1.67E+04	1.69E+02	No
Butyl Benzyl Phthlate	85-68-7	-	6.43E+04	6.43E+04	2.05E+05	1.51E+03	1.51E+03	1.00E+06	1.36E+05	1.36E+05	1.51E+03	No
Cadmium (Diet)	7440-43-9	3.59E+05	-	3.59E+05	6.84E+02	3.43E+03	6.84E+02	2.98E+03	9.65E+05	2.98E+03	6.84E+02	No
Carbon Tetrachloride	56-23-5	2.74E+01	7.01E+01	2.74E+01	7.22E+02	4.19E-01	4.19E-01	5.05E+02	1.13E+02	1.13E+02	4.19E-01	No
Chlordane (Gamma)	5566-34-7	3.67E+01	4.09E+00	4.09E+00	-	-	-	-	-	-	-	Yes
Chlorobenzene	108-90-7	-	4.57E+02	4.57E+02	5.78E+02	-	5.78E+02	5.27E+04	-	5.27E+04	5.78E+02	Yes
Chloroform	67-66-3	3.51E+01	1.00E+02	3.51E+01	8.54E+03	4.94E-01	4.94E-01	3.37E+04	1.39E+02	1.39E+02	4.94E-01	No
Chloromethane	74-87-3	5.51E+01	-	5.51E+01	1.86E+02	3.16E+00	3.16E+00	2.11E+05	8.63E+02	8.63E+02	3.16E+00	No
Chromium VI (particulates) (See Note 1)	18540-29-9	5.52E+04	8.52E+02	8.52E+02	2.53E+03	5.15E+02	5.15E+02	6.55E+04	1.45E+05	6.55E+04	5.15E+02	No
Chrysene	218-01-9	3.08E+00	-	3.08E+00	-	1.15E+02	1.15E+02	-	1.64E+04	1.64E+04	1.15E+02	Yes
Cyanide (CN-)	57-12-5	-	2.00E+02	2.00E+02	1.64E+04	-	1.64E+04	6.58E+04	-	6.58E+04	1.64E+04	Yes
Dibenz[a,h]anthracene	53-70-3	3.08E+00	-	3.08E+00	-	1.16E-01	1.16E-01	-	1.64E+01	1.64E+01	1.16E-01	No
Dibutyl Phthalate	84-74-2	-	3.21E+04	3.21E+04	1.07E+05	-	1.07E+05	1.00E+06	-	1.00E+06	1.07E+05	Yes
Dichlorobenzene, 1,4-	106-46-7	-	5.76E+03	5.76E+03	1.40E+04	1.23E+02	1.23E+02	4.91E+05	1.09E+04	1.09E+04	1.23E+02	No
Dichlorodiphenyl Dichloroethane, p, p' (DDD)	72-54-8	1.99E+02	-	1.99E+02	2.08E+03	1.21E+01	1.21E+01	7.42E+03	1.08E+03	1.08E+03	1.21E+01	No
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	1.40E+02	-	1.40E+02	-	8.55E+00	8.55E+00	-	7.64E+02	7.64E+02	8.55E+00	No
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	1.40E+02	3.41E+01	3.41E+01	4.43E+02	7.16E+00	7.16E+00	1.72E+03	7.02E+02	7.02E+02	7.16E+00	No
Dichloroethane, 1,1-	75-34-3	-	2.12E+03	2.12E+03	1.97E+03	-	1.97E+03	2.17E+05	-	2.17E+05	1.97E+03	No
Dichloroethane, 1,2-	107-06-2	2.38E+01	-	2.38E+01	2.13E+04	7.90E-01	7.90E-01	7.52E+04	2.11E+02	2.11E+02	7.90E-01	No
Dichloroethylene, 1,1-	75-35-4	4.44E+00	9.02E+01	4.44E+00	4.00E+02	1.10E-01	1.10E-01	3.99E+03	2.96E+01	2.96E+01	1.10E-01	No
Dichloroethylene, 1,2-cis-	156-59-2	-	1.00E+03	1.00E+03	1.07E+04	-	1.07E+04	3.76E+05	-	3.76E+05	1.07E+04	Yes
Dichloroethylene, 1,2-trans-	156-60-5	-	2.00E+03	2.00E+03	2.08E+02	-	2.08E+02	2.35E+03	-	2.35E+03	2.08E+02	No
Dichlorophenol, 2,4-	120-83-2	-	9.64E+01	9.64E+01	3.15E+03	-	3.15E+03	1.12E+04	-	1.12E+04	3.15E+03	Yes

Table 3-3
Comparison of Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil,
2007 ORNL RAIS Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Excavation Soil PRGs

		Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil			2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs				
Analyte	CAS No.	Worker Tier I Cancer (mg/kg)	Worker Tier I Non-Cancer (mg/kg)	More Stringent Cancer vs. Non-Cancer (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Outdoor Industrial and Excavation Soil PRGs?
Dieldrin	60-57-1	2.98E+00	3.41E+00	2.98E+00	5.02E+01	1.60E-01	1.60E-01	1.83E+02	1.55E+01	1.55E+01	1.60E-01	No
Dinitrotoluene, 2,4-	121-14-2	3.31E+01	-	3.31E+01	1.27E+03	2.61E+00	2.61E+00	5.69E+03	2.93E+02	2.93E+02	2.61E+00	No
Di-n-Octyl Phthalate	117-84-0	-	6.43E+02	6.43E+02	-	-	-	-	-	-	-	Yes
Endosulfan	115-29-7	-	1.36E+01	1.36E+01	6.02E+03	-	6.02E+03	2.19E+04	-	2.19E+04	6.02E+03	Yes
Endrin	72-20-8	-	2.04E+01	2.04E+01	7.92E+01	-	7.92E+01	4.65E+02	-	4.65E+02	7.92E+01	Yes
Ethylbenzene	100-41-4	-	2.50E+03	2.50E+03	9.26E+03	2.58E+01	2.58E+01	8.94E+04	7.26E+03	7.26E+03	2.58E+01	No
Ethylene Dibromide (Dibromoethane, 1,2-)	106-93-4	8.18E-02	-	8.18E-02	1.91E+02	9.48E-02	9.48E-02	4.82E+02	2.34E+01	2.34E+01	9.48E-02	Yes
Fluoranthene	206-44-0	3.08E+00	1.29E+04	3.08E+00	1.21E+04	-	1.21E+04	6.86E+05	-	6.86E+05	1.21E+04	Yes
Fluorene	86-73-7	3.08E+00	1.29E+04	3.08E+00	1.67E+04	-	1.67E+04	8.70E+05	-	8.70E+05	1.67E+04	Yes
Heptachlor	76-44-8	1.06E+01	3.41E+01	1.06E+01	5.20E+02	5.28E-01	5.28E-01	1.86E+03	5.39E+01	5.39E+01	5.28E-01	No
Heptachlor Epoxide	1024-57-3	5.24E+00	8.86E-01	8.86E-01	1.35E+01	2.65E-01	2.65E-01	4.83E+01	2.68E+01	2.68E+01	2.65E-01	No
Hexachlorobenzene	118-74-1	1.41E+01	2.57E+01	1.41E+01	8.03E+02	3.20E-01	3.20E-01	3.65E+02	6.51E+01	6.51E+01	3.20E-01	No
Hexachlorocyclohexane, Alpha- (BHC)	319-84-6	7.57E+00	-	7.57E+00	-	3.88E-01	3.88E-01	-	3.91E+01	3.91E+01	3.88E-01	No
Hexachlorocyclohexane, Beta- (BHC)	319-85-7	2.65E+01	-	2.65E+01	-	1.52E+00	1.52E+00	-	1.42E+02	1.42E+02	1.52E+00	No
Indeno[1,2,3-cd]pyrene	193-39-5	3.08E+00	-	3.08E+00	-	1.16E+00	1.16E+00	-	1.64E+02	1.64E+02	1.16E+00	No
Manganese (Water)	7439-96-5	-	4.21E+03	4.21E+03	3.19E+04	-	3.19E+04	1.77E+04	-	1.77E+04	1.77E+04	Yes
Mercury, Inorganic Salts	7487-94-7	-	1.28E+01	1.28E+01	3.11E+02	-	3.11E+02	1.11E+03	-	1.11E+03	3.11E+02	Yes
Methoxychlor	72-43-5	-	3.41E+02	3.41E+02	5.02E+03	-	5.02E+03	1.83E+04	-	1.83E+04	5.02E+03	Yes
Methyl Ethyl Ketone (2-Butanone)	78-93-3	-	2.29E+03	2.29E+03	-	-	-	-	-	-	-	Yes
Methylene Chloride (Dichloromethane)	75-09-2	4.59E+02	4.52E+02	4.52E+02	9.87E+03	2.19E+01	2.19E+01	8.30E+04	5.50E+03	5.50E+03	2.19E+01	No
Naphthalene	91-20-3	-	1.29E+03	1.29E+03	2.61E+02	-	2.61E+02	2.85E+03	-	2.85E+03	2.61E+02	No
Nickel Soluble Salts	7440-02-0	2.70E+06	8.52E+02	8.52E+02	2.22E+04	-	2.22E+04	7.66E+04	-	7.66E+04	2.22E+04	Yes
Nitrobenzene	98-95-3	-	1.08E+02	1.08E+02	1.58E+02	-	1.58E+02	1.08E+04	-	1.08E+04	1.58E+02	Yes
Phenanthrene	85-01-8	3.08E+00	-	3.08E+00	-	-	-	-	-	-	-	Yes
Phenol	108-95-2	-	1.93E+04	1.93E+04	3.17E+05	-	3.17E+05	1.00E+06	-	1.00E+06	3.17E+05	Yes
Piperidine, 1- (Phenylcyclohexyl,1-)	77-10-1	1.87E+02	9.64E+02	1.87E+02	-	-	-	-	-	-	-	Yes
Polychlorinated Biphenyls	27323-18-8	6.19E+00	-	6.19E+00	-	6.67E-01	6.67E-01	-	8.61E+01	8.61E+01	6.67E-01	No
Pyrene	129-00-0	3.08E+00	9.64E+03	3.08E+00	9.04E+03	-	9.04E+03	5.14E+05	-	5.14E+05	9.04E+03	Yes
Selenium	7782-49-2	-	2.13E+02	2.13E+02	5.59E+03	-	5.59E+03	1.92E+04	-	1.92E+04	5.59E+03	Yes
Silver	7440-22-4	-	2.13E+02	2.13E+02	5.48E+03	-	5.48E+03	1.90E+04	-	1.90E+04	5.48E+03	Yes
Tetrachloroethane, 1,1,2,2-	79-34-5	2.53E+01	-	2.53E+01	6.23E+04	1.03E+00	1.03E+00	2.23E+05	2.52E+02	2.52E+02	1.03E+00	No
Tetrachloroethylene	127-18-4	-	1.00E+03	1.00E+03	1.79E+03	1.30E+00	1.30E+00	2.27E+04	2.41E+02	2.41E+02	1.30E+00	No
Thallium (Soluble Salts)	7440-28-0	-	3.41E+01	3.41E+01	-	-	-	-	-	-	-	Yes
Toluene	108-88-3	-	3.59E+03	3.59E+03	2.60E+04	-	2.60E+04	7.74E+04	-	7.74E+04	2.60E+04	Yes
Trichloroethane, 1,1,1-	71-55-6	-	4.99E+03	4.99E+03	5.78E+03	-	5.78E+03	3.53E+05	-	3.53E+05	5.78E+03	Yes
Trichloroethane, 1,1,2-	79-00-5	6.47E+01	4.01E+02	6.47E+01	4.20E+03	2.05E+00	2.05E+00	1.49E+05	5.30E+02	5.30E+02	2.05E+00	No
Trichloroethylene	79-01-6	2.83E+02	-	2.83E+02	9.15E+01	8.99E-02	8.99E-02	6.14E+02	2.46E+01	2.46E+01	8.99E-02	No
Trichloropropane, 1,2,3-	96-18-4	-	6.01E+02	6.01E+02	6.29E+03	4.20E-01	4.20E-01	2.24E+05	3.73E+01	3.73E+01	4.20E-01	No

Table 3-3
Comparison of Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil, 2007 ORNL RAIS Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Excavation Soil PRGs

		Priority 2 and 3 Study Areas SI (1993) HECs Human Health Surface Soil			2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs				
Analyte	CAS No.	Worker Tier I Cancer (mg/kg)	Worker Tier I Non-Cancer (mg/kg)	More Stringent Cancer vs. Non-Cancer (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Are the Priority 2 & 3 Study Areas SI HEC More Stringent than the ORNL RAIS Outdoor Industrial and Excavation Soil PRGs?
Vanadium, Metallic	7440-62-2	-	2.98E+02	2.98E+02	4.79E+03	-	4.79E+03	2.08E+04	-	2.08E+04	4.79E+03	Yes
Vinyl Chloride	75-01-4	3.69E+00	-	3.69E+00	1.61E+02	4.25E-01	4.25E-01	1.63E+03	8.14E+01	8.14E+01	4.25E-01	No
Xylene, Mixture	1330-20-7	-	4.01E+04	4.01E+04	1.05E+03	-	1.05E+03	1.17E+04	-	1.17E+04	1.05E+03	No
Zinc (Metallic)	7440-66-6	-	8.52E+03	8.52E+03	3.30E+05	-	3.30E+05	1.00E+06	-	1.00E+06	3.30E+05	Yes

Note:
(1) The reported concentration for the Priority 2 and 3 HECs for Chromium is based on Total Chromium not Chromium IV.

Key:
HEC = hazard equivalent concentration
HI = hazard index
mg/kg = milligrams per kilogram
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
SI = Site Investigation/Inspection

Table 3-4
CS-4, CS-8 USCG, and CS-22 Contaminants of Concern
Comparison of 2007 ORNL RAIS Residential Soil PRGs
to Removal Action Levels

		ORNL RAIS Residential Soil PRGs (May 2007)				
Analyte	**CAS No.**	**Total Soil PRG HI = 1 (mg/kg)**	**Total Soil PRG Risk = 1E-6 (mg/kg)**	**More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)**	**Removal Action Level (mg/kg)**	**Is the RAL More Stringent than the ORNL RAIS Residential Soil PRG?**
CS-4 COCs						
Aroclor 1260	11096-82-5	-	5.10E-01	5.10E-01	1.00E+00	No
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	-	4.74E+00	4.74E+00	2.27E-01	Yes
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	3.12E+02	4.25E+00	4.25E+00	2.50E-01	Yes
Dieldrin	60-57-1	3.38E+01	9.52E-02	9.52E-02	3.50E-02	Yes
Lead and Compounds	7439-92-1	-	-	-	3.00E+02	Yes
		-	-	-	9.90E+01	Yes
Zinc (Metallic)	7440-66-6	2.15E+05	-	2.15E+05	6.80E+01	Yes
CS-8 USCG COCs						
Cadmium (Diet)	7440-43-9	5.22E+02	5.31E+03	5.22E+02	1.8E+00	Yes
Manganese (Water)	7439-96-5	2.66E+04	-	2.66E+04	2.7E+02	Yes
Aroclor 1254	11097-69-1	9.01E+00	5.00E-01	5.00E-01	1.0E+00	No
CS-22 COCs						
Aluminum	7429-90-5	6.79E+05	-	6.79E+05	8.9E+03	Yes
Arsenic, Inorganic	7440-38-2	1.7E+02	8.8E-01	8.8E-01	7.1E+00	No
Benz[a]anthracene	56-55-3	-	8.7E-01	8.7E-01	7.0E-01	Yes
Benzo[a]pyrene	50-32-8	-	8.7E-02	8.7E-02	6.3E-01	No
Benzo[b]fluoranthene	205-99-2	-	8.7E-01	8.7E-01	7.0E-01	Yes
Chromium VI (particulates)	18540-29-9	1.82E+03	8.0E+02	8.0E+02	1.9E+01	Yes
Dibenz[a,h]anthracene	53-70-3	-	8.7E-02	8.7E-02	7.0E-01	No
Indeno[1,2,3-cd]pyrene	193-39-5	-	8.7E-01	8.7E-01	7.0E-01	Yes
Lead and Compounds	7439-92-1	-	-	-	9.9E+01	Yes
Selenium	7782-49-2	3.62E+03	-	3.62E+03	1.0E+00	Yes

Key:
COC = contaminant of concern
CS = Chemical Spill
HI = hazard index
mg/kg = milligrams per kilogram
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
RAL = removal action level
USCG = U.S. Coast Guard

Table 3-5
Comparison of DSRP Soil Target Cleanup Levels (1999) & 2007 ORNL RAIS Risk-Based Residential Soil PRGs

Analyte	CAS No.	DSRP STCLs Outside Flightline (Residential) (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Residential Soil PRGs			Is the ORNL RAIS Residential Soil PRG More Stringent Than The DSRP STCL?	Is the ORNL RAIS Residential Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6		
Acenaphthene	83-32-9	3.29E+03		1.64E+04	-	1.64E+04	No	
Acetone	67-64-1	5.49E+03		6.27E+05	-	6.27E+05	No	
Aldrin	309-00-2	1.26E-01		2.03E+01	9.07E-02	9.07E-02	Yes	
Aluminum	7429-90-5	5.49E+04	8.93E+03	6.79E+05	-	6.79E+05	No	No
Anthracene	120-12-7	1.00E+04		1.30E+05	-	1.30E+05	No	
Antimony (metallic)	7440-36-0	2.20E+01	1.75E+01	2.43E+02	-	2.43E+02	No	No
Aroclor 1016	12674-11-2	1.58E-01		3.15E+01	4.85E-01	4.85E-01	No	
Aroclor 1221	11104-28-2	1.58E-01		-	5.25E-01	5.25E-01	No	
Aroclor 1232	11141-16-5	1.58E-01		-	5.25E-01	5.25E-01	No	
Aroclor 1242	53469-21-9	1.58E-01		-	4.85E-01	4.85E-01	No	
Aroclor 1248	12672-29-6	1.58E-01		-	5.25E-01	5.25E-01	No	
Aroclor 1254	11097-69-1	1.58E-01		9.01E+00	5.00E-01	5.00E-01	No	
Aroclor 1260	11096-82-5	1.58E-01		-	5.10E-01	5.10E-01	No	
Arsenic, Inorganic	7440-38-2	3.60E+00	3.60E+00	1.70E+02	8.79E-01	8.79E-01	Yes	Yes
Barium	7440-39-3	3.80E+03	1.40E+01	1.29E+05	-	1.29E+05	No	No
Benz[a]anthracene	56-55-3	5.00E+00		-	8.70E-01	8.70E-01	Yes	
Benzene	71-43-2	1.00E-02		3.24E+02	3.25E+00	3.25E+00	No	
Benzo(g,h,i)perylene	191-24-2	5.00E+00		-	-	-	No	
Benzo[a]pyrene	50-32-8	5.00E+00		-	8.72E-02	8.72E-02	Yes	
Benzo[b]fluoranthene	205-99-2	5.00E+00		-	8.73E-01	8.73E-01	Yes	
Benzo[k]fluoranthene	207-08-9	5.00E+00		-	8.73E+00	8.73E+00	No	
Beryllium and compounds	7440-41-7	1.00E+00	6.50E-01	1.03E+03	2.83E-01	2.83E-01	Yes	Yes
Bis(2-chloroethyl)ether	111-44-4	7.00E-01		-	4.76E-01	4.76E-01	Yes	
Bis(2-ethylhexyl)phthalate	117-81-7	4.57E+01		1.21E+04	1.01E+02	1.01E+02	No	
Bromodichloromethane	75-27-4	1.00E-01		1.40E+04	2.64E+01	2.64E+01	No	
Bromoform	75-25-2	1.00E-01		1.37E+04	6.97E+01	6.97E+01	No	
Bromomethane	74-83-9	1.00E+01		2.79E+01	-	2.79E+01	No	
Butyl Benzyl Phthlate	85-68-7	1.10E+04		1.37E+05	8.41E+02	8.41E+02	Yes	
Cadmium (Diet)	7440-43-9	2.64E+01	1.50E+00	5.22E+02	5.31E+03	5.22E+02	No	No
Carbazole	86-74-8	3.20E+01		-	8.06E+01	8.06E+01	No	
Carbon Tetrachloride	56-23-5	1.00E-02		4.81E+02	6.27E-01	6.27E-01	No	
Chlordane	57-74-9	1.00E+00		2.63E+02	3.61E+00	3.61E+00	No	
Chlordane (Gamma)	5566-34-7	1.64E+00		NA	NA	NA	No	
Chloroaniline, p-	106-47-8	1.00E+00		2.70E+03	2.92E+01	2.92E+01	No	

Table 3-5
Comparison of DSRP Soil Target Cleanup Levels (1999) & 2007 ORNL RAIS Risk-Based Residential Soil PRGs

Analyte	CAS No.	DSRP STCLs Outside Flightline (Residential) (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Residential Soil PRGs			Is the ORNL RAIS Residential Soil PRG More Stringent Than The DSRP STCL?	Is the ORNL RAIS Residential Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6		
Chlorobenzene	108-90-7	1.00E-01		1.02E+03	-	1.02E+03	No	
Chloroform	67-66-3	1.00E-01		6.09E+03	7.63E-01	7.63E-01	No	
Chloromethane	74-87-3	7.20E-01		3.45E+02	4.77E+00	4.77E+00	No	
Chlorophenol, 2-	95-57-8	2.74E+02		3.38E+03	-	3.38E+03	No	
Chromium VI (particulates) (See Note 1)	18540-29-9	2.74E+02	1.90E+01	1.82E+03	7.96E+02	7.96E+02	No	No
Chrysene	218-01-9	8.77E+01		-	8.72E+01	8.72E+01	Yes	
Cresol, o- (Methylphenol, 2)	95-48-7	3.30E-01		3.38E+04	-	3.38E+04	No	
Cresol, p- (Methylphenol, 4)	106-44-5	3.30E-01		3.44E+03	-	3.44E+03	No	
Cyanide (CN-)	57-12-5	1.10E+03	7.00E-01	1.18E+04	-	1.18E+04	No	No
Dibenz[a,h]anthracene	53-70-3	5.00E+00		-	8.73E-02	8.73E-02	Yes	
Dibenzofuran	132-64-9	2.20E+02		1.39E+03	-	1.39E+03	No	
Dibromochloromethane	124-48-1	9.00E-02		1.37E+04	1.90E+01	1.90E+01	No	
Dibutyl Phthalate	84-74-2	5.49E+03		7.02E+04	-	7.02E+04	No	
Dichlorobenzene, 1,2-	95-50-1	1.00E+02		6.56E+03	-	6.56E+03	No	
Dichlorobenzene, 1,3-	541-73-1	1.00E+02		-	-	-	No	
Dichlorobenzene, 1,4-	106-46-7	2.67E+01		2.59E+04	6.80E+01	6.80E+01	No	
Dichlorobenzidine, 3,3'-	91-94-1	1.00E+00		-	3.51E+00	3.51E+00	No	
Dichlorodiphenyl Dichloroethane, p, p' (DDD)	72-54-8	8.89E+00		1.38E+03	6.71E+00	6.71E+00	Yes	
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	6.28E+00		-	4.74E+00	4.74E+00	Yes	
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	6.28E+00		3.12E+02	4.25E+00	4.25E+00	Yes	
Dichloroethane, 1,1-	75-34-3	2.59E+02		3.59E+03	-	3.59E+03	No	
Dichloroethane, 1,2-	107-06-2	1.00E-02		1.40E+04	1.17E+00	1.17E+00	No	
Dichloroethylene, 1,1-	75-35-4	1.00E-02		7.32E+02	1.64E-01	1.64E-01	No	
Dichloroethylene, 1,2-cis-	156-59-2	7.00E-02		7.02E+03	-	7.02E+03	No	
Dichloroethylene, 1,2-trans-	156-60-5	1.10E+03		3.79E+02	-	3.79E+02	Yes	
Dichlorophenol, 2,4-	120-83-2	3.30E-01		2.09E+03	-	2.09E+03	No	
Dichloropropane, 1,2-	78-87-5	1.00E-02		4.96E+01	2.38E+01	2.38E+01	No	
Dichloropropene, 1,3- (cis + trans)	542-75-6	1.00E-02		1.39E+04	-	1.39E+04	No	
Dieldrin	60-57-1	1.33E-01		3.38E+01	9.52E-02	9.52E-02	Yes	
Diethyl Phthalate	84-66-2	1.00E+04		5.59E+05	-	5.59E+05	No	
Dimethyl Phthalate	131-11-3	3.00E+01		1.00E+06	-	1.00E+06	No	
Dimethylphenol, 2,4-	105-67-9	1.10E+03		1.35E+04	-	1.35E+04	No	
Dinitrophenol, 2,4-	51-28-5	8.00E-01		1.40E+03	-	1.40E+03	No	
Dinitrotoluene, 2,4-	121-14-2	3.30E-01		9.87E+02	1.69E+00	1.69E+00	No	

Table 3-5
Comparison of DSRP Soil Target Cleanup Levels (1999) & 2007 ORNL RAIS Risk-Based Residential Soil PRGs

Analyte	CAS No.	DSRP STCLs Outside Flightline (Residential) (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Residential Soil PRGs			Is the ORNL RAIS Residential Soil PRG More Stringent Than The DSRP STCL?	Is the ORNL RAIS Residential Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6		
Di-n-Octyl Phthalate	117-84-0	1.10E+03		NA	NA	NA	No	
Endosulfan	115-29-7	6.00E+01		4.06E+03	-	4.06E+03	No	
Endosulfan II	891-86-1	2.00E-01		NA	NA	NA	No	
Endrin	72-20-8	5.49E+01		7.31E+01	-	7.31E+01	No	
Ethylbenzene	100-41-4	7.00E-01		1.49E+04	4.00E+01	4.00E+01	No	
Fluoranthene	206-44-0	2.20E+03		1.09E+04	-	1.09E+04	No	
Fluorene	86-73-7	2.20E+03		1.43E+04	-	1.43E+04	No	
Heptachlor	76-44-8	1.70E-03		3.46E+02	3.32E-01	3.32E-01	No	
Heptachlor Epoxide	1024-57-3	2.35E-01		8.99E+00	1.65E-01	1.65E-01	Yes	
Hexachlorobenzene	118-74-1	4.00E-01		5.41E+02	3.75E-01	3.75E-01	Yes	
Hexachlorobutadiene	87-68-3	3.00E+00		1.35E+02	2.44E+00	2.44E+00	Yes	
Hexachlorocyclohexane, Alpha- (BHC)	319-84-6	3.39E-01		-	2.41E-01	2.41E-01	Yes	
Hexachlorocyclohexane, Beta- (BHC)	319-85-7	1.19E+00		-	8.80E-01	8.80E-01	Yes	
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	1.64E+00		1.88E+02	1.13E+00	1.13E+00	Yes	
Hexachloroethane	67-72-1	6.00E+00		6.76E+02	3.81E+01	3.81E+01	No	
Hexanone, 2	591-78-6	2.20E+03		-	-	-	No	
Indeno[1,2,3-cd]pyrene	193-39-5	5.00E+00		-	8.73E-01	8.73E-01	Yes	
Isophorone	78-59-1	6.74E+02		1.35E+05	1.66E+03	1.66E+03	No	
Lead and Compounds	7439-92-1	3.00E+02	9.90E+01	-	-	-	No	No
Manganese (Water)	7439-96-5	2.74E+02	1.08E+02	2.66E+04	-	2.66E+04	No	No
Mercury, Inorganic Salts	7487-94-7	1.65E+01	6.00E-02	2.07E+02	-	2.07E+02	No	No
Methoxychlor	72-43-5	9.15E+02		3.38E+03	-	3.38E+03	No	
Methyl Ethyl Ketone (2-Butanone)	78-93-3	9.26E+02		NA	NA	NA	No	
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	108-10-1	5.00E-01		NA	NA	NA	No	
Methylene Chloride (Dichloromethane)	75-09-2	1.00E-02		1.43E+04	3.08E+01	3.08E+01	No	
Methylnaphthalene, 2-	91-57-6	7.00E-01		2.78E+03	-	2.78E+03	No	
Naphthalene	91-20-3	2.20E+03		4.71E+02	-	4.71E+02	Yes	
Nickel Soluble Salts	7440-02-0	1.10E+03	5.20E+00	1.44E+04	-	1.44E+04	No	No
Nitroaniline, 2	88-74-4	8.00E-01		9.35E+01	-	9.35E+01	No	
Nitroaniline, 3	99-09-2	8.00E-01		2.09E+02	7.73E+01	7.73E+01	No	
Nitrobenzene	98-95-3	2.74E+01		1.90E+02	-	1.90E+02	No	
Pentachlorophenol	87-86-5	5.34E+00		1.10E+04	7.11E+00	7.11E+00	No	
Phenanthrene	85-01-8	2.20E+03		-	-	-	No	
Phenol	108-95-2	1.00E+04		2.10E+05	-	2.10E+05	No	

Table 3-5
Comparison of DSRP Soil Target Cleanup Levels (1999) & 2007 ORNL RAIS Risk-Based Residential Soil PRGs

Analyte	CAS No.	DSRP STCLs Outside Flightline (Residential) (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Residential Soil PRGs			Is the ORNL RAIS Residential Soil PRG More Stringent Than The DSRP STCL?	Is the ORNL RAIS Residential Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6		
Pyrene	129-00-0	1.65E+03		8.19E+03	-	8.19E+03	No	
Selenium	7782-49-2	2.74E+02	3.30E-01	3.62E+03	-	3.62E+03	No	No
Silver	7440-22-4	2.74E+02	2.40E+00	3.57E+03	-	3.57E+03	No	No
Styrene	100-42-5	1.00E-01		2.64E+04	-	2.64E+04	No	
Tetrachloroethane, 1,1,2,2-	79-34-5	8.13E-01		4.14E+04	1.42E+00	1.42E+00	No	
Tetrachloroethylene	127-18-4	1.00E-02		2.54E+03	1.41E+00	1.41E+00	No	
Thallium (Soluble Salts)	7440-28-0	4.39E+00	2.50E-01	-	-	-	No	No
Toluene	108-88-3	1.00E+00		3.10E+04	-	3.10E+04	No	
Toxaphene	8001-35-2	1.70E-01		-	1.42E+00	1.42E+00	No	
Trichlorobenzene, 1,2,4-	120-82-1	4.89E+02		3.12E+02	-	3.12E+02	Yes	
Trichloroethane, 1,1,1-	71-55-6	2.00E-01		1.02E+04	-	1.02E+04	No	
Trichloroethane, 1,1,2-	79-00-5	1.00E-02		2.78E+03	2.96E+00	2.96E+00	No	
Trichloroethylene	79-01-6	1.00E-02		1.07E+02	1.36E-01	1.36E-01	No	
Trichlorophenol, 2,4,5-	95-95-4	3.00E+00		6.76E+04	-	6.76E+04	No	
Trichlorophenol, 2,4,6-	88-06-2	3.00E+00		-	1.32E+02	1.32E+02	No	
Vanadium, Metallic	7440-62-2	3.84E+02	1.52E+01	3.65E+03	-	3.65E+03	No	No
Vinyl Chloride	75-01-4	1.00E-02		2.74E+02	4.74E-01	4.74E-01	No	
Xylene, Mixture	1330-20-7	1.00E+01		1.93E+03	-	1.93E+03	No	
Zinc (Metallic)	7440-66-6	1.00E+04	1.60E+01	2.15E+05	-	2.15E+05	No	No

Note:
(1) The reported concentration for the DSRP STCL for Chromium is based on Total Chromium not Chromium IV.

Key:

DSRP = Drainage Structure Removal Program
HI = hazard index
mg/kg = milligrams per kilogram
MMR = Massachusetts Military Reservation
NA = not applicable
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
RAL = removal action level
STCL = soil target cleanup level

Table 3-6
Comparision of DSRP Soil Target Cleanup Levels (1999), 2007 ORNL RAIS Risk Based Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Risk Based Excavation Soil PRGs

				2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs					
Analyte	CAS No.	DSRP STCLs Inside Flightline (Human Only) 0-15 ft bgs (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than the DSRP STCL?	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than MMR Background (Inorganics Only)?
Acenaphthene	83-32-9	1.00E+04		1.81E+04	-	1.81E+04	1.00E+06	-	1.00E+06	1.81E+04	No	
Acetone	67-64-1	1.00E+04		9.47E+05	-	9.47E+05	1.00E+06	-	1.00E+06	9.47E+05	No	
Aldrin	309-00-2	1.00E+00		3.01E+01	1.55E-01	1.55E-01	1.46E+02	1.47E+01	1.47E+01	1.55E-01	Yes	
Aluminum	7429-90-5	5.82E+04	8.93E+03	9.71E+05	-	9.71E+05	1.00E+06	-	1.00E+06	9.71E+05	No	No
Anthracene	120-12-7	1.00E+04		1.60E+05	-	1.60E+05	1.00E+06	-	1.00E+06	1.60E+05	No	
Antimony (metallic)	7440-36-0	2.33E+01	1.75E+01	3.42E+02	-	3.42E+02	6.73E+02	-	6.73E+02	3.42E+02	No	No
Aroclor 1016	12674-11-2	3.83E+00		3.92E+01	6.57E-01	6.57E-01	1.85E+02	8.54E+01	8.54E+01	6.57E-01	Yes	
Aroclor 1221	11104-28-2	3.83E+00		-	7.84E-01	7.84E-01	-	9.24E+01	9.24E+01	7.84E-01	Yes	
Aroclor 1232	11141-16-5	3.83E+00		-	7.84E-01	7.84E-01	-	9.24E+01	9.24E+01	7.84E-01	Yes	
Aroclor 1242	53469-21-9	3.83E+00		-	6.57E-01	6.57E-01	-	8.54E+01	8.54E+01	6.57E-01	Yes	
Aroclor 1248	12672-29-6	3.83E+00		-	7.84E-01	7.84E-01	-	9.24E+01	9.24E+01	7.84E-01	Yes	
Aroclor 1254	11097-69-1	3.83E+00		1.12E+01	7.03E-01	7.03E-01	1.32E+02	8.81E+01	8.81E+01	7.03E-01	Yes	
Aroclor 1260	11096-82-5	3.83E+00		-	7.32E-01	7.32E-01	-	8.97E+01	8.97E+01	7.32E-01	Yes	
Arsenic, Inorganic	7440-38-2	1.16E+01	3.60E+00	2.30E+02	1.43E+00	1.43E+00	9.52E+02	1.48E+02	1.48E+02	1.43E+00	Yes	Yes
Barium	7440-39-3	4.07E+03	1.40E+01	1.75E+05	-	1.75E+05	2.59E+05	-	2.59E+05	1.75E+05	No	No
Benz[a]anthracene	56-55-3	2.79E+01		-	1.15E+00	1.15E+00	-	1.64E+02	1.64E+02	1.15E+00	Yes	
Benzene	71-43-2	1.00E-02		1.89E+02	2.26E+00	2.26E+00	1.93E+03	5.83E+02	5.83E+02	2.26E+00	No	
Benzo(g,h,i)perylene	191-24-2	2.33E+03		-	-	-	-	-	-	-	No	
Benzo[a]pyrene	50-32-8	2.79E+00		-	1.16E-01	1.16E-01	-	1.64E+01	1.64E+01	1.16E-01	Yes	
Benzo[b]fluoranthene	205-99-2	2.79E+01		-	1.16E+00	1.16E+00	-	1.64E+02	1.64E+02	1.16E+00	Yes	
Benzo[k]fluoranthene	207-08-9	2.79E+02		-	1.16E+01	1.16E+01	-	1.64E+03	1.64E+03	1.16E+01	Yes	
Beryllium and compounds	7440-41-7	4.73E+00	6.50E-01	1.33E+03	4.45E-01	4.45E-01	1.45E+04	4.85E+01	4.85E+01	4.45E-01	Yes	Yes
Bis(2-chloroethyl)ether	111-44-4	7.00E-01		-	3.90E-01	3.90E-01	-	8.32E+01	8.32E+01	3.90E-01	Yes	
Bis(2-ethylhexyl)phthalate	117-81-7	1.16E+03		1.69E+04	1.69E+02	1.69E+02	6.69E+04	1.67E+04	1.67E+04	1.69E+02	Yes	
Bromodichloromethane	75-27-4	1.00E-01		2.13E+04	4.80E+01	4.80E+01	7.51E+04	4.24E+03	4.24E+03	4.80E+01	No	
Bromoform	75-25-2	1.00E-01		2.05E+04	5.78E+01	5.78E+01	1.11E+05	1.22E+04	1.22E+04	5.78E+01	No	
Bromomethane	74-83-9	1.00E+01		1.53E+01	-	1.53E+01	2.94E+03	-	2.94E+03	1.53E+01	No	
Butyl Benzyl Phthlate	85-68-7	1.16E+05		2.05E+05	1.51E+03	1.51E+03	1.00E+06	1.36E+05	1.36E+05	1.51E+03	Yes	
Cadmium (Diet)	7440-43-9	2.73E+01	1.50E+00	6.84E+02	3.43E+03	6.84E+02	2.98E+03	9.65E+05	2.98E+03	6.84E+02	No	No
Carbazole	86-74-8	1.02E+03		-	1.45E+02	1.45E+02	-	1.30E+04	1.30E+04	1.45E+02	Yes	
Carbon Tetrachloride	56-23-5	1.00E-02		7.22E+02	4.19E-01	4.19E-01	5.05E+02	1.13E+02	1.13E+02	4.19E-01	No	
Chlordane	57-74-9	5.00E+00		3.29E+02	5.65E+00	5.65E+00	1.86E+02	6.12E+02	1.86E+02	5.65E+00	No	
Chlordane (Gamma)	5566-34-7	1.16E+01		-	-	-	-	-	-	-	No	
Chloroaniline, p-	106-47-8	1.00E+00		4.01E+03	5.20E+01	5.20E+01	1.46E+04	4.73E+03	4.73E+03	5.20E+01	No	
Chlorobenzene	108-90-7	1.00E-01		5.78E+02	-	5.78E+02	5.27E+04	-	5.27E+04	5.78E+02	No	
Chloroform	67-66-3	1.00E-01		8.54E+03	4.94E-01	4.94E-01	3.37E+04	1.39E+02	1.39E+02	4.94E-01	No	
Chloromethane	74-87-3	4.09E+01		1.86E+02	3.16E+00	3.16E+00	2.11E+05	8.63E+02	8.63E+02	3.16E+00	Yes	
Chlorophenol, 2-	95-57-8	2.91E+03		5.02E+03	-	5.02E+03	1.83E+05	-	1.83E+05	5.02E+03	No	

Table 3-6
Comparision of DSRP Soil Target Cleanup Levels (1999), 2007 ORNL RAIS Risk Based Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Risk Based Excavation Soil PRGs

Analyte	CAS No.	DSRP STCLs Inside Flightline (Human Only) 0-15 ft bgs (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs			More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than the DSRP STCL?	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)			
Chromium VI (particulates)	18540-29-9	1.16E+03	1.90E+01	2.53E+03	5.15E+02	5.15E+02	6.55E+04	1.45E+05	6.55E+04	5.15E+02	Yes	No
Chrysene	218-01-9	4.00E+02		-	1.15E+02	1.15E+02	-	1.64E+04	1.64E+04	1.15E+02	Yes	
Cresol, o- (Methylphenol, 2)	95-48-7	3.30E-01		5.02E+04	-	5.02E+04	1.00E+06	-	1.00E+06	5.02E+04	No	
Cresol, p- (Methylphenol, 4)	106-44-5	3.30E-01		5.15E+03	-	5.15E+03	1.85E+04	-	1.85E+04	5.15E+03	No	
Cyanide (CN-)	57-12-5	1.16E+03	7.00E-01	1.64E+04	-	1.64E+04	6.58E+04	-	6.58E+04	1.64E+04	No	No
Dibenz[a,h]anthracene	53-70-3	2.79E+00		-	1.16E-01	1.16E-01	-	1.64E+01	1.64E+01	1.16E-01	Yes	
Dibenzofuran	132-64-9	2.33E+03		2.10E+03	-	2.10E+03	7.46E+03	-	7.46E+03	2.10E+03	Yes	
Dibromochloromethane	124-48-1	9.00E-02		2.05E+04	3.41E+01	3.41E+01	7.37E+05	3.07E+03	3.07E+03	3.41E+01	No	
Dibutyl Phthalate	84-74-2	5.82E+04		1.07E+05	-	1.07E+05	1.00E+06	-	1.00E+06	1.07E+05	No	
Dichlorobenzene, 1,2-	95-50-1	2.00E+02		3.79E+03	-	3.79E+03	3.92E+05	-	3.92E+05	3.79E+03	No	
Dichlorobenzene, 1,3-	541-73-1	2.00E+02		-	-	-	-	-	-	-	No	
Dichlorobenzene, 1,4-	106-46-7	8.48E+02		1.40E+04	1.23E+02	1.23E+02	4.91E+05	1.09E+04	1.09E+04	1.23E+02	Yes	
Dichlorobenzidine, 3,3'-	91-94-1	3.00E+00		-	6.24E+00	6.24E+00	-	5.68E+02	5.68E+02	6.24E+00	No	
Dichlorodiphenyl Dichloroethane, p, p' (DDD)	72-54-8	1.00E+02		2.08E+03	1.21E+01	1.21E+01	7.42E+03	1.08E+03	1.08E+03	1.21E+01	Yes	
Dichlorodiphenyl Dichloroethylene, p,p' (DDE)	72-55-9	9.00E+01		-	8.55E+00	8.55E+00	-	7.64E+02	7.64E+02	8.55E+00	Yes	
Dichlorodiphenyltrichloroethanep,p' (DDT)	50-29-3	9.00E+01		4.43E+02	7.16E+00	7.16E+00	1.72E+03	7.02E+02	7.02E+02	7.16E+00	Yes	
Dichloroethane, 1,1-	75-34-3	4.78E+03		1.97E+03	-	1.97E+03	2.17E+05	-	2.17E+05	1.97E+03	Yes	
Dichloroethane, 1,2-	107-06-2	1.00E-02		2.13E+04	7.90E-01	7.90E-01	7.52E+04	2.11E+02	2.11E+02	7.90E-01	No	
Dichloroethylene, 1,1-	75-35-4	1.00E-02		4.00E+02	1.10E-01	1.10E-01	3.99E+03	2.96E+01	2.96E+01	1.10E-01	No	
Dichloroethylene, 1,2-cis-	156-59-2	7.00E-02		1.07E+04	-	1.07E+04	3.76E+05	-	3.76E+05	1.07E+04	No	
Dichloroethylene, 1,2-trans-	156-60-5	1.00E+04		2.08E+02	-	2.08E+02	2.35E+03	-	2.35E+03	2.08E+02	Yes	
Dichlorophenol, 2,4-	120-83-2	3.30E-01		3.15E+03	-	3.15E+03	1.12E+04	-	1.12E+04	3.15E+03	No	
Dichloropropane, 1,2-	78-87-5	1.00E-02		2.67E+01	4.29E+01	2.67E+01	9.78E+02	3.83E+03	9.78E+02	2.67E+01	No	
Dichloropropene, 1,3- (cis + trans)	542-75-6	1.00E-02		2.10E+04	-	2.10E+04	7.46E+05	-	7.46E+05	2.10E+04	No	
Dieldrin	60-57-1	2.00E+00		5.02E+01	1.60E-01	1.60E-01	1.83E+02	1.55E+01	1.55E+01	1.60E-01	Yes	
Diethyl Phthalate	84-66-2	1.00E+04		8.46E+05	-	8.46E+05	1.00E+06	-	1.00E+06	8.46E+05	No	
Dimethyl Phthalate	131-11-3	3.00E+01		1.00E+06	-	1.00E+06	1.00E+06	-	1.00E+06	1.00E+06	No	
Dimethylphenol, 2,4-	105-67-9	1.00E+04		2.01E+04	-	2.01E+04	7.30E+05	-	7.30E+05	2.01E+04	No	
Dinitrophenol, 2,4-	51-28-5	8.00E-01		2.13E+03	-	2.13E+03	7.52E+03	-	7.52E+03	2.13E+03	No	
Dinitrotoluene, 2,4-	121-14-2	3.30E-01		1.27E+03	2.61E+00	2.61E+00	5.69E+03	2.93E+02	2.93E+02	2.61E+00	No	
Di-n-Octyl Phthalate	117-84-0	1.16E+03		-	-	-	-	-	-	-	No	
Endosulfan	115-29-7	6.00E+01		6.02E+03	-	6.02E+03	2.19E+04	-	2.19E+04	6.02E+03	No	
Endosulfan II	891-86-1	2.00E-01		-	-	-	-	-	-	-	No	
Endrin	72-20-8	5.82E+01		7.92E+01	-	7.92E+01	4.65E+02	-	4.65E+02	7.92E+01	No	
Ethylbenzene	100-41-4	7.00E-01		9.26E+03	2.58E+01	2.58E+01	8.94E+04	7.26E+03	7.26E+03	2.58E+01	No	
Fluoranthene	206-44-0	1.00E+04		1.21E+04	-	1.21E+04	6.86E+05	-	6.86E+05	1.21E+04	No	
Fluorene	86-73-7	1.00E+04		1.67E+04	-	1.67E+04	8.70E+05	-	8.70E+05	1.67E+04	No	
Heptachlor	76-44-8	7.00E+00		5.20E+02	5.28E-01	5.28E-01	1.86E+03	5.39E+01	5.39E+01	5.28E-01	Yes	

Table 3-6
Comparision of DSRP Soil Target Cleanup Levels (1999), 2007 ORNL RAIS Risk Based Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Risk Based Excavation Soil PRGs

				2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs					
Analyte	CAS No.	DSRP STCLs Inside Flightline (Human Only) 0-15 ft bgs (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than the DSRP STCL?	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than MMR Background (Inorganics Only)?
Heptachlor Epoxide	1024-57-3	2.52E+00		1.35E+01	2.65E-01	2.65E-01	4.83E+01	2.68E+01	2.68E+01	2.65E-01	Yes	
Hexachlorobenzene	118-74-1	1.27E+01		8.03E+02	3.20E-01	3.20E-01	3.65E+02	6.51E+01	6.51E+01	3.20E-01	Yes	
Hexachlorobutadiene	87-68-3	3.00E+00		2.01E+02	1.71E+00	1.71E+00	2.44E+03	4.36E+02	4.36E+02	1.71E+00	Yes	
Hexachlorocyclohexane, Alpha- (BHC)	319-84-6	1.08E+01		-	3.88E-01	3.88E-01	-	3.91E+01	3.91E+01	3.88E-01	Yes	
Hexachlorocyclohexane, Beta- (BHC)	319-85-7	3.77E+01		-	1.52E+00	1.52E+00	-	1.42E+02	1.42E+02	1.52E+00	Yes	
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	5.22E+01		2.68E+02	1.92E+00	1.92E+00	1.03E+04	1.86E+02	1.86E+02	1.92E+00	Yes	
Hexachloroethane	67-72-1	3.00E+01		1.00E+03	3.14E+01	3.14E+01	3.65E+04	6.65E+03	6.65E+03	3.14E+01	No	
Hexanone, 2	591-78-6	2.33E+03		-	-	-	-	-	-	-	No	
Indeno[1,2,3-cd]pyrene	193-39-5	2.79E+01		-	1.16E+00	1.16E+00	-	1.64E+02	1.64E+02	1.16E+00	Yes	
Isophorone	78-59-1	2.14E+04		2.01E+05	2.96E+03	2.96E+03	1.00E+06	2.69E+05	2.69E+05	2.96E+03	Yes	
Lead and Compounds	7439-92-1	1.00E+03	9.90E+01	-	-	-	-	-	-	-	No	No
Manganese (Water)	7439-96-5	8.14E+03	1.08E+02	3.19E+04	-	3.19E+04	1.77E+04	-	1.77E+04	1.77E+04	No	No
Mercury, Inorganic Salts	7487-94-7	1.75E+01	6.00E-02	3.11E+02	-	3.11E+02	1.11E+03	-	1.11E+03	3.11E+02	No	No
Methoxychlor	72-43-5	9.70E+02		5.02E+03	-	5.02E+03	1.83E+04	-	1.83E+04	5.02E+03	No	
Methyl Ethyl Ketone (2-Butanone)	78-93-3	1.00E+04		-	-	-	-	-	-	-	No	
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	108-10-1	5.00E-01		-	-	-	-	-	-	-	No	
Methylene Chloride (Dichloromethane)	75-09-2	1.00E-02		9.87E+03	2.19E+01	2.19E+01	8.30E+04	5.50E+03	5.50E+03	2.19E+01	No	
Methylnaphthalene, 2-	91-57-6	7.00E-01		4.20E+03	-	4.20E+03	1.49E+04	-	1.49E+04	4.20E+03	No	
Naphthalene	91-20-3	2.33E+03		2.61E+02	-	2.61E+02	2.85E+03	-	2.85E+03	2.61E+02	Yes	
Nickel Soluble Salts	7440-02-0	1.16E+03	5.20E+00	2.22E+04	-	2.22E+04	7.66E+04	-	7.66E+04	2.22E+04	No	No
Nitroaniline, 2	88-74-4	8.00E-01		5.19E+01	-	5.19E+01	3.85E+03	-	3.85E+03	5.19E+01	No	
Nitroaniline, 3	99-09-2	8.00E-01		3.15E+02	1.40E+02	1.40E+02	1.12E+03	1.24E+04	1.12E+03	1.40E+02	No	
Nitrobenzene	98-95-3	1.74E+02		1.58E+02	-	1.58E+02	1.08E+04	-	1.08E+04	1.58E+02	Yes	
Pentachlorophenol	87-86-5	1.70E+02		1.29E+04	1.00E+01	1.00E+01	6.64E+04	1.29E+03	1.29E+03	1.00E+01	Yes	
Phenanthrene	85-01-8	2.33E+03		-	-	-	-	-	-	-	No	
Phenol	108-95-2	1.00E+04		3.17E+05	-	3.17E+05	1.00E+06	-	1.00E+06	3.17E+05	No	
Polychlorinated biphenyls (PCBs)	1336-36-3	NA				0.00E+00			0.00E+00	0.00E+00	Yes	
Pyrene	129-00-0	1.00E+04		9.04E+03	-	9.04E+03	5.14E+05	-	5.14E+05	9.04E+03	Yes	
Selenium	7782-49-2	2.91E+02	3.30E-01	5.59E+03	-	5.59E+03	1.92E+04	-	1.92E+04	5.59E+03	No	No
Silver	7440-22-4	2.91E+02	2.40E+00	5.48E+03	-	5.48E+03	1.90E+04	-	1.90E+04	5.48E+03	No	No
Styrene	100-42-5	1.00E-01		1.62E+04	-	1.62E+04	3.30E+05	-	3.30E+05	1.62E+04	No	
Tetrachloroethane, 1,1,2,2-	79-34-5	2.00E+01		6.23E+04	1.03E+00	1.03E+00	2.23E+05	2.52E+02	2.52E+02	1.03E+00	Yes	
Tetrachloroethylene	127-18-4	1.00E-02		1.79E+03	1.30E+00	1.30E+00	2.27E+04	2.41E+02	2.41E+02	1.30E+00	No	
Thallium (Soluble Salts)	7440-28-0	4.65E+01	2.50E-01	-	-	-	-	-	-	-	No	No
Toluene	108-88-3	1.00E+00		2.60E+04	-	2.60E+04	7.74E+04	-	7.74E+04	2.60E+04	No	
Toxaphene	8001-35-2	1.70E-01		-	2.49E+00	2.49E+00	-	2.31E+02	2.31E+02	2.49E+00	No	
Trichlorobenzene, 1,2,4-	120-82-1	5.78E+02		1.73E+02	-	1.73E+02	3.62E+04	-	3.62E+04	1.73E+02	Yes	
Trichloroethane, 1,1,1-	71-55-6	2.00E-01		5.78E+03	-	5.78E+03	3.53E+05	-	3.53E+05	5.78E+03	No	

Table 3-6
Comparision of DSRP Soil Target Cleanup Levels (1999), 2007 ORNL RAIS Risk Based Outdoor Industrial Soil PRGs, and 2007 ORNL RAIS Risk Based Excavation Soil PRGs

Analyte	CAS No.	DSRP STCLs Inside Flightline (Human Only) 0-15 ft bgs (mg/kg)	MMR Background (Inorganics Only) (mg/kg)	2007 ORNL RAIS Outdoor Industrial Soil PRGs			2007 ORNL RAIS Excavation Soil PRGs			More Stringent Outdoor Industrial Soil PRG vs. Excavation Soil PRG (mg/kg)	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than the DSRP STCL?	Is the ORNL RAIS Outdoor Industrial/ Excavation Soil PRG More Stringent Than MMR Background (Inorganics Only)?
				Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)	Total Soil PRG HI = 1 (mg/kg)	Total Soil PRG Risk = 1E-6 (mg/kg)	More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)			
Trichloroethane, 1,1,2-	79-00-5	1.00E-02		4.20E+03	2.05E+00	2.05E+00	1.49E+05	5.30E+02	5.30E+02	2.05E+00	No	
Trichloroethylene	79-01-6	1.00E-02		9.15E+01	8.99E-02	8.99E-02	6.14E+02	2.46E+01	2.46E+01	8.99E-02	No	
Trichlorophenol, 2,4,5-	95-95-4	3.00E+00		1.00E+05	-	1.00E+05	1.00E+06	-	1.00E+06	1.00E+05	No	
Trichlorophenol, 2,4,6-	88-06-2	3.00E+00		-	2.05E+02	2.05E+02	-	2.15E+04	2.15E+04	2.05E+02	No	
Vanadium, Metallic	7440-62-2	4.07E+02	1.52E+01	4.79E+03	-	4.79E+03	2.08E+04	-	2.08E+04	4.79E+03	No	No
Vinyl Chloride	75-01-4	1.00E-02		1.61E+02	4.25E-01	4.25E-01	1.63E+03	8.14E+01	8.14E+01	4.25E-01	No	
Xylene, Mixture	1330-20-7	1.00E+01		1.05E+03	-	1.05E+03	1.17E+04	-	1.17E+04	1.05E+03	No	
Zinc (Metallic)	7440-66-6	1.00E+04	1.60E+01	3.30E+05	-	3.30E+05	1.00E+06	-	1.00E+06	3.30E+05	No	No

Note:
(1) The reported concentration for the DSRP STCL for Chromium is based on Total Chromium not Chromium IV.

Key:
DSRP = Drainage Structure Removal Program
ft bgs = feet below ground surface
HI = hazard index
mg/kg = milligrams per kilogram
MMR = Massachusetts Military Reservation
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
STCL = soil target cleanup level

Table 3-7
Comparison of 2007 ORNL RAIS Residential Soil PRGs to SARAP Inorganics Removal Action Levels

		ORNL RAIS Residential Soil PRGs (May 2007)				
Analyte	**CAS No.**	**Total Soil PRG HI = 1 (mg/kg)**	**Total Soil PRG Risk = 1E-6 (mg/kg)**	**More Stringent HI = 1 vs. Risk = 1E-6 (mg/kg)**	**Removal Action Level (mg/kg)**	**Is the RAL More Stringent than the ORNL RAIS Residential Soil PRG?**
Inorganics						
Aluminum	7429-90-5	6.79E+05	-	6.79E+05	8.90E+03	Yes
Arsenic, Inorganic	7440-38-2	1.7E+02	8.8E-01	8.79E-01	7.10E+00	No
Cadmium (Diet)	7440-43-9	5.22E+02	5.31E+03	5.22E+02	1.80E+00	Yes
Chromium VI (particulates)	18540-29-9	1.82E+03	8.0E+02	7.96E+02	1.90E+01	Yes
Copper	7440-50-8	2.88E+04	-	2.88E+04	6.10E+01	Yes
Cyanide (CN-)	57-12-5	1.18E+04	-	1.18E+04	1.00E+00	Yes
Lead and Compounds	7439-92-1	-	-	-	9.90E+01	Yes
Manganese (Water)	7439-96-5	2.66E+04	-	2.66E+04	2.74E+02	Yes
Mercury	7487-94-7	2.07E+02	-	2.07E+02	1.80E-01	Yes
Vanadium	7440-62-2	3.65E+03	-	3.65E+03	4.70E+01	Yes
Zinc (Metallic)	7440-66-6	2.15E+05	-	2.15E+05	6.80E+01	Yes

Key:
HI = hazard index
mg/kg = milligrams per kilogram
ORNL = Oak Ridge National Laboratory
PRG = Preliminary Remedial Goals
RAIS = Risk Assessment Information System
RAL = removal action level
SARAP = Source Area Remedial Action Program

Table 4-1
5 Year Review Groundwater Sites

No.	Groundwater 5-Year Review Sites	Doc. Type	Doc. Date	Human Risk Assessment
1	Ashumet Valley	Feasibility Study	Jun-07	Residential Exposure
2	CS-4	ROD	Feb-00	Residential Exposure
3	CS-10	RI	Sep-01	Residential Exposure
4	CS-19	IROD	Apr-06	Residential Exposure
5	CS-20	ROD	Feb-00	Residential Exposure
6	CS-21	ROD	Feb-00	Residential Exposure
7	CS-23	ROD	Sep-07	Residential Exposure
8	Eastern Briarwood	ROD	Sep-06	Residential Exposure
9	FS-1	ROD	Apr-00	Residential Exposure
10	FS-12	ROD	Sep-06	Residential Exposure
11	FS-13	ROD	Feb-00	Residential Exposure
12	FS-28	ROD	Oct-00	Residential Exposure
13	FS-29	ROD	Oct-00	Residential Exposure
14	LF-1	ROD	Sep-07	Residential Exposure
15	SD-5	ROD	Sep-06	Residential Exposure
16	Western Aquafarm	ROD	Sep-06	Residential Exposure

Key:
CS = Chemical Spill
FS = Fuel Spill
LF = Landfill
RI = Remedial Investigation
ROD = Record of Decision
SD = Storm Drain